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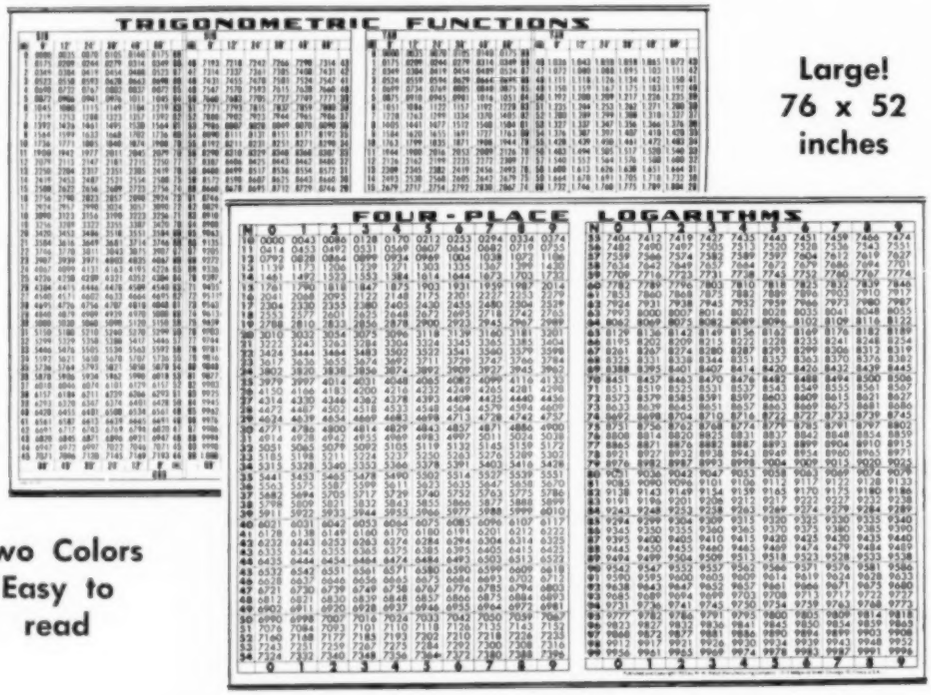

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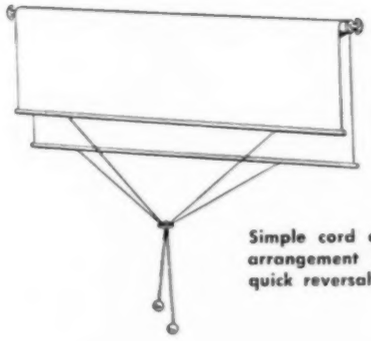

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Problems in Photosynthesis
By Robert B. Gordon, Dept. of Science, Pennsylvania State Teacher's College, West Chester, Penna.

•

ERROR — The name of the author of the article, "Why Not Semimicro?" in the March, 1959 issue was incorrectly listed. It should read "By Sister Ernestine Marie O'Connell, S.C.H., D.Ed., (Boston University).

Textile Careers for Students of Science?

• By **Stewart J. Hungerford, B.Sc.** *(McGill)*, **S.M.** *(M. I. T.)*
PRESIDENT, TEXTILE TECHNICAL FEDERATION OF CANADA

The birth of the textile industry was responsible for the Industrial Revolution.

Today, research by physicists, mathematicians, chemists, and engineers in the development of new fabrics is creating a revolution in the textile industry which will open many new careers to future scientists.

●

At no other time in the long history of the Canadian textile industry have the opportunities for well trained young men and women been better than they are at the present time. The indicated course of events suggests ever widening application to textiles of all the scientific skills which man possesses. What is clearly indicated are tremendous changes in the traditional methods of the production of textiles and garments. These changes are inevitable and will present opportunity and challenge.

Clothing and textiles are a basic necessity of mankind. Since the earliest times man has sought to devise clothing—first, for its functional values in protecting him from the elements, and later, clothing having both functional and aesthetic characteristics. Regardless of what changes take place in the textile industry as we now know it, one thing is certain, man will continue to demand clothing with constantly improving standards of performance to conform to the changing pattern of his life brought about by technological development. The automobile, improved methods of home heating and suburban living developed during the last fifty years or so have brought about vast sociological changes which, in turn, have had a direct effect upon the clothing requirements of man.

Historically the textile industry is old, having originated in ancient times. From about 5000 B.C. to the present day, the useful applications of fiber to yarns and fabrics has been brought to a high state of perfection and excellence. The ingenuity and skill of many craftsmen was necessary and at times progress was painful and slow. The significant fact remains however that all this progress was accomplished largely by trial and error methods and even today we cannot design fabrics and accurately predict the outcome. We can produce acceptable fabrics as the result of years of experience and training, but we cannot *engineer* them in the same way that a bridge may be constructed. Why? Because the fundamental nature of fiber, yarns and fabrics has been long ignored. In the year 1937, F. T. Peirce of England outlined a scientific study of the performance of yarns in fabrics in a paper entitled "Geometry of Cloth Structure." This was perhaps the earliest attempt to characterize such structures in scientific and mathematical terms. Later Dr. Harold Dewitt Smith made further investigations which were presented to the American Society for Testing Materials when he delivered the Edgar Marburg lecture in 1944. These men were true pioneers and set a pattern to be followed by many, notably Dr. Walter J. Hamburger of Boston who delivered the 1955 Edgar Marburg lecture and brought the A.S.T.M. members up-to-date on the progress made since the Smith address in 1944. Concurrently much work is being done in the field of high polymer chemistry where scientists are gathering the information necessary for them to put together molecular structures having fiber forming properties. If the work of the physicists and engineers in the field of yarn and fabric geometry reaches a satisfactory level at the same time as the chemists can truly engineer a fiber, then we shall be able to select fiber, construct yarns and manufacture fabrics with predictable results in functional and perhaps aesthetic properties. This would be a tremendous advance in textile technology and would eliminate costly trial and error methods which are all too prevalent today. At the same time, it means that the demand for technically trained people in the industry with a scientific education will be unprecedented. Nor will the demand be narrow. Physicists, mathematicians, chemists, engineers and perhaps even psychologists will be required to determine man's needs in textile products and to produce the required articles. All this implies that a fundamental approach to the understanding of textiles is underway. It is true that in the applied scientific sense much is being done today which will have far reaching effects on the industry in a few years and which will necessitate the engagement of an ever increasing army of scientists and technologists. Let's take a look at what is going on in the industry right now.

Traditionally most yarns have been made from short fibers such as cotton (about 1" in length) and wool (ranging from 2" to perhaps 5" or more). In any event, yarns of these fibers have to be made by bringing many individual fibers together, making them roughly parallel, and twisting them to give the yarn strength through fiber cohesion. When the man-made fibers came along they were spun in a continuous bundle of filaments to form a yarn of almost infinite length. Naturally it followed that spinners of cotton and woolen yarns sought to make spun yarns from waste filament yarns. Eventually the man-made fiber producers cut their continuous filament yarns into short lengths suitable for the spinning systems originally devised for cotton and wool and called their new product *staple fiber*. It was not long, however, before men sought to give continuous filament yarns some of the characteristics of spun yarns without cutting it into staple. From this thought was born what are today called "Textured Yarns" and many have made their appear-

ance on the market within the past few years. Moreover, it was discovered that, when made of certain fibers, widely differing characteristics could be imparted to the yarn. Thus today we recognize three basically different types of textured yarns all however having the bulked characteristic as in spun yarns. The first of these were the textured "stretch" yarns which, in socks and hosiery, were quickly adopted as a means of making a few sizes do the work of many. The application of such yarns in the industry is today in its infancy and already variations such as two fiber textured "stretch" yarns are becoming commonplace.

The second group are the textured "crimp" yarns. These usually possess some stretch but not as much as the textured "stretch" yarns. They are used to make fabrics resembling those made from the traditional fibers but in many cases creating new textures not previously obtainable. The third group are sometimes referred to as textured "stable" yarns since they possess high bulk but no stretch. They yield fabrics with interesting surface textures and their application will be widely extended in the years immediately ahead. Generally such yarns are rather costly which limits their use but it is safe to hazard the opinion that in a few years technical developments sponsored by scientists and technologists will improve the methods of manufacture and thereby expand their use through cost reduction.

Increased productivity is another "must" for the industry. We have seen the migration of textile industry from the New England States to the South occasioned by high wages; the result of general industrial development along the Atlantic Seaboard. Highly industrialized areas drive the textile industry out. Why? It would seem to be the result of relatively low productivity per employee relative to the productivity of workers in industries other than textiles, particularly those requiring high capital investment. It follows that the industries with high capital investment per worker also show an above-average interest in the subject of industrial research. Figures have been quoted that show that against the 5% or 6% of the sales dollar spent by the chemical industry in the United States on research, and against an average figure of about 2% for all U. S. industry, the textile industry is spending only about 0.1%. This cannot continue. Already the paper and plastics industries, both supporters of substantial research effort, are nibbling at traditional textile markets. The more alert members of the textile industry recognize this and are doing something about it. It will not be many years in my estimation before a great deal more will be done in the field of textile research by the industry as the means to continued existence. This development will snow-ball and herein lies the opportunities for young Canada and the United States.

In the length of this article it is not possible to even touch on the many developments which are going forward today and which will in time materially alter the nature of the textile products purchased by Mr. and Mrs. North America. I have not had the opportunity to describe, for instance, a new type of garment closure made entirely in the industry of textile materials, washable and virtually indestructible which will, wherever it finds application, eliminate the need for buttons, hooks, or the common zipper. Interesting too are the nonwoven fabrics which are slowly emerging. A group of new materials, the ultimate uses for which must remain sheer conjecture at the present time. Further off but on the horizon are moulded garments. These and many others are in the development stage or are seeking commercial acceptance at the present time. Two points must be made here. The first is that, in many cases the original prototype may not be entirely successful. Ultimately technological improvement will, however, greatly extend the acceptance of such products. The second point is that the frequency of new developments is accelerating and the future is definitely exciting.

To accomplish these things I have described will require the best brains that the country can provide. Nor will there be any dearth of financial incentive for those who elect to follow a career in textile technology or textile science. Recent studies made by the Arthur D. Little organization clearly demonstrate that the economic position of textile college graduates *after a few years* is higher than the average of technically trained college graduates in most other industries.

I can best sum up the scientific opportunities in the many branches of our vast primary textile industry by quoting the words of one of Canada's leading textile industrialists who recently addressed a gathering of Quebec educationalists visiting l'Institute des Textiles de la Province de Quebec. The Institute, established in 1945 by the Quebec government, provides a four year course for students wishing to further a career in textiles.

At this particular meeting, Dr. Francois E. Cleyn, president of the Canadian Woollen and Knit Goods Manufacturers Association, and director of the Primary Textiles Institute said, "the large and efficient Canadian textile industry needs leaders, trained to provide the techniques and new ideas which are the life-blood of any industry.

"To maintain this efficiency, and the healthy growth of our industry, we must remain efficient. And for this we need more technically trained people, those, who in 20 years will be guiding the destiny of the textile industry," he said.

"The Canadian industry is fully aware of the fact that during the past decade or more, the world textile industry, which was responsible for the Industrial Revolution, has been experiencing a period of further transformation where the trend is from a mechanical to a scientific industry.

"Textile career men of the future will be scientists," Dr. Cleyn added.

In choosing a career this is certainly something to be thought about. ●

What To Do About a New Kind of Freshman?

• By J. H. Neelley
PROFESSOR OF MATHEMATICS, CARNEGIE INSTITUTE OF TECHNOLOGY, PITTSBURGH, PENNSYLVANIA

The impact of changes in high school mathematics is already affecting our colleges. The author discusses some of the problems of advanced placement.

This paper was presented to the Allegheny Mountain Section of M.A.A. in May 1958 and to the Pittsburgh Diocesan Science and Mathematics Teachers Association on February 7, 1959.

●

A hysterical press, band-wagon politicians, confused high school administrators harassed by an ignorant public and scared educationists in the Teachers' Colleges are forcing upon the colleges and universities another problem. The problem of the high school taught calculus.

Since Sputnik I made its appearance, this excited horde has shouted over radio, on T. V., in the press, and even in the street for more scientists even at the high school level. Absurd, utterly absurd "sputnikitis." Once again the mass proves itself indubitably wrong.

The Problem of Advanced Placement

At Carnegie Tech, we had our first such freshmen last fall. They were generally bright young people, but tests showed that they merely had some formulas. They knew not the why of calculus. However, some were permitted to enter second semester courses in analytics and calculus. This we did not like to do. It was bad, very bad, to put these bright ambitious students in classes with the failures of the previous year. They had to get a completely wrong idea of college work from these flunkers.

Others were not permitted to omit the first semester. Such decisions were made after the students were given individual examinations. These too were unhappy as they had been told in high school that they would have advanced credit. The fact is that no such student gets any credit. Their high school courses are of the simplest possible types, due to teachers of little experience in higher mathematics and to the choices of the most innocuous texts available. Hence no credit can be given. Those who start in the second semester courses merely have to take something to replace the hours toward a degree which were omitted.

But back to those who were not given advanced standing. At first they were sure they had not gotten a square deal. Then they came to me later in the semester with statements like, "I now know why and not merely how," or "I would have missed a lot if I had been allowed to start with the second semester." It seems to me that such statements are very significant. They definitely point to the general futility of high school taught analytics and calculus.

College Board Examinations

Another problem which we of the colleges face is the question of where to put such students when they offer the College Board examinations as reason for advanced standing. This is because such examinations cut across college courses rather than cover one or two courses. Any omission will mean a loss of what can be very important topics and ideas.

Since many colleges and universities have shifted total responsibility to high schools for all algebra and trigonometry, we are assuming that the students acquire sufficient knowledge of these subjects to permit them to handle college courses in analytics and calculus—a violent assumption. I say this because from 12% to 20% of our freshmen fail their first course in college mathematics, and this would be much higher if we, like many, did not use fellows, graduate students and low ranking members of the staff as freshmen instructors. Needless to say, such instructors pass as many as they possibly can to make their records look good. However, this practice merely makes the percentage of failures in the sophomore courses higher.

Failures In College Mathematics

The college administrations seem to think that approximately 12% is as high as should be failed. This, of course, is based on the care with which students are admitted. Really there is no care in choice of entrants. Most institutions have more apply than they should take, but they accept them until the quotas are filled. This is done because delay in accepting a student means that he had been accepted at one of the other places of application. Hence we do not pick—the quota must be filled. So, we take them and fail them and everybody is disturbed about it, but cannot change the situation.

A study of our courses and failures over the past three years has pointed particularly to poor algebra and trigonometry as the fundamental reasons. Hence I have worked out a list of topics in mathematics for high school students who plan to go to college[1]. A study of this list will certainly point out that the high schools have enough to do without attempting to teach college subjects also.

My sincere conclusion on this problem is that we of the colleges and universities should test any student offering analytics or calculus and be very critical of his right to advanced standing. I urge that no credit be given and that advanced standing be granted very rarely and that in such cases a close check be kept on such students. I urge you to discourage the schools in your areas in teaching analytics and calculus. Point out to them the high casualty list of their students as of now; propose more algebra and analytic trigo-

(Continued on Page 71)

The Apothecary Jar

An Historical Sketch of Drug Containers Through the Ages

• **By George Griffenhagen**
CURATOR, DIVISION OF MEDICAL SCIENCES, SMITHSONIAN INSTITUTION

The evolution of pharmacy, medicine, and the ceramic arts is reflected in the history of the use and development of the apothecary jar.

Historians, scientists, and artists are numbered among the collectors of these most interesting relics of the remote and recent past.

All illustrations are presented through the courtesy of the Smithsonian Institution, Washington, D. C.

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From earliest times, those who prepared and sold drugs were faced with the problem of preserving and storing the medicines with which they dealt. The introduction of "remedies" must have been the result of primitive man's earliest instincts for survival, and the introduction of containers to hold these medicaments must be nearly as old. Earliest recorded history tells of trade in drugs; for example about 2250 B.C. there existed an important traffic in drugs and spices between Babylonia and Egypt. Dealers in drugs had their stalls together on a separate street in Sippara on the Euphrates about the time of the Babylonian king Hammurabi (2000 B.C.), and at the same time drug vendors sold their wares in the streets of Thebes and other ancient Egyptian cities along the Nile. Containers for these drugs took an infinite variety of forms, the most common of which are the Egyptian alabaster pots for eye cosmetics and ointment, shown in Figure 1.

The preservation of drugs in proper containers was given a good deal of attention by the ancient Greeks and Romans. They employed vessels of clay and alabaster for oils and ointments, lead for solid substances, and glass, horn and earthenware for liquids. The famous Greek physician, Dioscorides (1st century A.D.) gave precise instructions for drug containers; he prescribed limewood boxes for storing strong flowers, leaves, seeds and aromatic substances; and gums were to be kept in little bags of goatskin. Fats, pulps and remedies for eye diseases were to be stored in tin boxes.

The ancient Greeks gained a high degree of perfection in making ceramics, developing a distinctive style of decoration and a variety of shapes and forms, each with a special name and designed for a special purpose. The *lekythos*, shown in Figure 2, was used for holding oils, and other liquids, such as cosmetics and medicine, which were used in small amounts.

The real development of the specialized drug jar, however, had its beginning in the Middle East during the period of Islamic conquest and domination. Persia and the surrounding area produced many of the precious drugs and spices, and records indicate that in Baghdad in the 8th century, there was established the first privately owned but governmentally supervised

FIGURE 1. Egyptian alabaster *khol* pot, made about the 18th Dynasty.

FIGURE 2. This Greek *lekythos*, made about 500 B. C. of red pottery with black decorations, once held oil like cosmetics and medicines which were used in small amounts.

FIGURE 3. This albarello, with black decorations and turquoise glaze, was made at Rakka, Mesopotamia about 1200 A. D. The albarello was developed in Persia during the 11th century.

FIGURE 4. This copper luster and cobalt blue albarello, with its typical ivy-leaf design, was made at Valencia about 1450, where the best Hispano-Moresque lusterware was made. This jar is the property of Sydney N. Blumberg of Newtown, Conn.

FIGURE 5. This drug pot, decorated with manganese brown triangles filled with copper green on a yellowish lead glaze, was made at or near Orvieto during the late 14th or early 15th century.

pharmacies. At the same time, potters were developing a new kind of ceramic and a unique style of jar which has been intimately associated with pharmacy. The innovation in the ceramic art was the use of a glaze to produce a non-porous earthenware which was much more suitable for storing liquid and semi-liquid medicaments. This method of glazing was known in ancient Mesopotamia but was never generally adopted for earthenware. The unique jar developed in the Middle East was the albarello, a cylindrical container with concave sides curving inward toward the middle of the jar. The earliest albarello known is a fragmentary jar from Amul, Persia (Iran) attributed to the 11th century, now preserved at the Art Institute of Chicago. This albarello-shape was also known in ancient Mesopotamia where as early as 1500 B. C. unglazed albarello-shaped drinking cups were used. Even though the shape does not appear to have been used in other vessels, these drinking cups certainly must have served as the precursor of the true Persian 11th century albarello.

Among the earliest albarelli made in the Middle East ascribed as drug jars are those made at Rakka, Mesopotamia, situated on the Euphrates about 100 miles from Aleppo (Haleb) Syria. A typical Rakka albarello, dating from about 1200 B. C. (illustrated in Figure 3) shows the black Arabic decoration under a turquoise glaze. Covering this was a transparent alkaline glaze, recently removed to reveal the decoration underneath; the glaze had been rendered opaque and heavily encrusted with iridescence through decay caused by many years of burial in the Syrian soil.

The armies of Islam conquered Spain during the 8th century, carrying with them the Islamic culture. Cordova, capital of the Western Caliphate of the Islamic world, carried on an important trade in drugs and spices, and public pharmacies followed the pattern established in Baghdad. The eariest potteries in Spain for producing the glazed earthenware were established at Malaga on the Mediterranean coast near Gibraltar. In the writings of a Mussulman traveler in 1350 we learn that at Malaga "they manufacture a beautiful kind of golden pottery which they export to the most distant countries." The art of lustre-painting was particularly perfected up the coast from Malaga at Valencia, and in nearby Manisses and Paterna. Hispano-Moresque lustreware is the term generally applied to this pottery made by the Moors in Spain decorated with a golden copper lustre, and often with colbalt blue on a white lead and tin oxide glazed background. The albarello shown in Figure 4 is an excellent example of the skill developed by the 15th century Valencian potters. Although the decorations of the Hispano-Moresque albarelli varied considerably, the over-all ivy-leaf pattern of this jar was the most frequently employed on albarelli of the second half of the 15th century.

Until the 13th century, the production of pottery in Italy remained a crude art, but with the influence of the Islamic art which penetrated Italy simultaneously with the commerce in drugs, new centers for the manufacture of glazed earthenware, called "majolica," were established. The earliest Italian majolica appears to have been made at or near Orvieto during the late 14th century; one such Orvieto albarello, decorated with manganese brown and copper green on a yellowish lead glaze is depicted in Figure 5. From this crude pottery developed the Florentine "oak-leaf" jars of the mid-15th century, and the Faenza "Gothic-foliage" decoration of the late 15th century. It is from Faenza, where so many famous potteries existed that the name "faience" was derived.

Other famous centers for the production of Italian majolica during the 15th and 16th centuries include

FIGURE 6. This albarello is an excellent example of Castle Durante majolica of the mid-16th century. The label stands for CONSERVA VIOLARUM or Conserves of Violets; the practice of labeling the jars was popularized in the 16th century.

FIGURE 7. This French faience albarello was made at Nimes in 1585. The original is in the Musee Sévres, Paris, and is the only drug jar pictured on these pages not on exhibit at the Smithsonian.

FIGURE 8. This drug jar, called a "pot-a-canon," was made at Strasbourg during the 18th century. The label on the jar stands for UNGUENTUM MUNDIFICATUM or Cleansing Ointment.

FIGURE 9. This drug jar is an important and rare sample of early German faience. It was made by the famous potter Lorenz Speckner of Creussen during the first half of the 17th century.

FIGURE 10. This German flint glass drug jar, with fused enamel label, was made in the 1700's for a pharmacy at Mainz. The label stands for SAL VOLATILE LUMBRICORUM or Volatile Salt of Earthworms.

FIGURE 11. This 18th century Dutch Delft drug jar carries the typical peacock motif. The potter's mark is that of Johannis Pennis (1723-1774) and the label stands for CONFECTIO URTICAE ROMANAE or Confection of Roman Nettles.

FIGURE 12. This 17th century plainly decorated English delft ointment pot is typical of those found in excavations at Jamestown, Virginia, and other 17th century American colonial settlements.

FIGURE 13. The blue and white cherub design on this drug jar was the most common decoration on 18th century English "Lambeth delft" drug jars. The label stands for UNGUENTUM TUTTIAE or Tutty Ointment.

FIGURE 14. This syrup jar, dated 1797, was made at the Vienna Porcelain Manufactory. The label stands for SYRUPUS SCILLAE or Syrup of Squill.

FIGURE 15. This typical canopy-top French porcelain drug jar was made at Limoges after 1891 for export to Latin America. The label stands for AZUCAR NARANJADA PURGANTE or Purgative Sugar of Orange.

Caffaggiolo, Siena, Deruta, Castle Durante, Urbino, Venice and Palermo. The early majolica from Caffaggiolo (near Florence) often imitated the patterns of Hispano-Moresque ware, while 16th century Caffaggiolo is often recognizable by the polychrome "pinecone" and the peacock feather decorative patterns. Distinguishable marks of Siena were the use of a typical "Siense brown," tightly bound wreaths of foliage enclosing the decoration, and wavy ribbons adjacent to the main decoration.

At Castle Durante the artist potters were responsible for the tall slightly-waisted albarelli decorated with drums, weapons, busts of warriors and portrait medallions. Figure 6 shows a typical 16th century Castle Durante albarello with a helmeted warrior, decorated in bright green, deep blue and yellow-brown. The addition of the drug inscription directly on the jar also became a common practice during the 16th century.

This type of albarello was much imitated by potteries in Palermo, Sicily, and may often be identified by the SPQP *(Senatus populusque Panormitanus)* inscription worked into the decoration. These Sicilian imitations are also more waisted and generally have a glazed recessed base.

FIGURE 16. The bottle on the left is called a "saltmouth," and the one on the right a "tincture." Both have the curved "glass label" typical of American glass drug botttles after 1860.

The skill of the Italian potters spread into France by the 16th century, and as early as 1512, Italian potters are known to have commenced work at Lyons. According to records, a Rouen potter in 1543 made "a very large number of drug pots for a local apothecary" which were decorated in the Italian style with a portrait head in profile, and a Nimes potter who commenced business in 1548 made a specialty of "apothecaries' pots made after the fashion of Pisa." The decoration is so characteristically Italian that one need have no doubt as to where the early French potters learned their trade. Only the potter's mark enables us to affirm that they are of French manufacture. Figure 7 shows one such albarello manufactured at Nimes in 1585.

Other leading centers for the production of more typical French faience were later established at Moustiers, Saint Cloud, Strasbourg and Niderwiller. The Strasbourg faience, such as the "pot-a-canon" or modified albarello pictured in Figure 8, is typified by rich and elegant flower decorations with the predominant use of crimson for roses, and other flowers; of green for foliage; and of blue for forget-me-nots. The glaze was exceptionally white. Characteristic features of 18th century French drug jars was the serpentine or ornate twisted handles on the elaborate "electuary jars"; an electuary was a medicine made by mixing powders and other drugs with syrup or honey into a soft preparation which melts in the mouth.

The best known of the German potteries were those of Nuremberg, Bayreauth, Ansbach, and Creussen. Early Nuremberg faience was strongly influenced by

Italian designs, but drug jars of the 18th century were characterized by distinctive blue wreaths surrounding the inscription and a peculiarly formed loop at the bottom of the wreath. Most easily recognizable of the unique German designs was that of Creussen. During the first half of the 17th century Lorenz Speckner of Creussen developed an over-all spiral motif, executed exclusively in blue on white faience. Figure 9 depicts an early 17th century Speckner drug jar with the characteristic spiral motif, which according to Hannover is "that of the draftsman or calligrapher rather than the painter."

More common among German drug jars are the glass drug containers, like the one pictured in Figure 10. These glass drug containers, manufactured largely in the mountainous section of central Germany and in Bohemia, were in common use from the end of the 17th century until the middle of the 19th century. Most of the bottles are of flint glass, and the labels are fused enamel, often using alchemical symbols in place of the more common Latinized titles. In size they vary from a capacity of about 4 ounces to about a gallon, although most of them fall in a range of about 8 to 16 ounces.

The art of tin-enameling earthenware was introduced into The Netherlands during the early part of the 16th century by Italian potters who settled in Antwerp. From here, the faience industry spread to Rotterdam, Haarlem, Breda and Middelburg. By the 17th century the Dutch town of Delft became famous for the manufacture of glazed earthenware decorated in blue and white in imitation of the Chinese porcelain then being imported by the Dutch East India Company. While monotone blue prevailed in Delft pottery, polychrome drug jars were produced. Due to the overwhelming success of the Delft potters, the general term "Delftware" eventually replaced the terms majolica and faience for the tin-glazed earthenware of Holland. The typical leaf decoration so characteristic of Italian majolica was used by the very early Dutch potters, but as the art developed unique Dutch decorations appeared on the drug jars. The most typical of Delft apothecary jars, seen in Figure 11 is the peacock motif, consisting of two peacocks standing on either end of a scroll, facing a basket of fruit in the center. Beneath is an angel's head. The peacock motif was in use as early as 1665, and remained the most generally employed motif on Delft drug jars for the following hundred years.

The art of tin-enameling earthenware was introduced into England by two potters who came from Antwerp about the year 1567. In their petition to Queen Elizabeth I they asked permission to settle in England and manufacture "Gally paving Tiles and Vessels for Apothecaries and others." Early 17th century drug jars were either unpainted or decorated with stripes and simple patterns, as the ointment pot illustrated in Figure 12. The stripes are blue, and the glaze is slightly pink, differentiating it from pure white Dutch Delft. This is the type of drug containers which are found in excavations at Jamestown and other 17th century American colonial settlements.

Even though drug jars were made at Bristol and Liverpool, the center of production developed at Lambeth. Due to the strong influence of the Dutch Delft, the English wares have become known as "Lambeth delft." The cherub motif, seen in Figure 13 is more frequently encountered than any other on 18th century English drug jars. A cherub holding a sprig of foliage or a trumpet sits at either end of a scrollwork cartouche.

Porcelain, as distinguished from majolica or faience, was in use in China for hundreds of years before its introduction into the Western world. Potters and chemists experimented in vain to discover the Chinese formula for making porcelain, but not until 1709 did one succeed. He was a chemist named Johann Frederick Boettger, and the secret was found to lie in the use of two essential ingredients—kaolin and petuntse. Boettger's discovery led to the establishment of a porcelain manufactory at Meissen, a few miles from Dresden. At first there was an effort to prevent the secret of the manufacture of porcelain from becoming known, and all types of precautions were taken at Meissen to prevent the employees there from deserting. Nevertheless in 1720 a workman carried the secret to Vienna where a factory was established, and it wasn't long thereafter before similar factories were established throughout Europe.

Eighteenth century porcelain drug jars are a rarity, and most of these were made after 1775. Figure 14 shows a porcelain syrup jar made at the Vienna Porcelain Manufactory and dated 1797. Other early porcelain drug jars are known to have been produced at the Rorstrand Porcelain Factory of Stockholm, Sweden in 1771, at the Royal Porcelain Works of Copenhagen, Denmark after 1779; and at Limbach, (Thuringia) Germany about 1795.

Many early attempts in France to produce porcelain proved unsuccessful. However as early as 1693 a new type of ceramic, often called "soft porcelain" was made at Chicaneau. Strictly speaking, this was not a porcelain, but was made from finely ground glass mixed with clay and fired at a low temperature. Several factories were established in France for the manufacture of this "soft porcelain," best known of which was first at Vincennes near Paris and later transferred to Sévres. This type of soft porcelain was made there until 1804 when the manufacture was discontinued.

In spite of considerable improvements in the manufacture of Sévres soft porcelain, the factory, in 1761, purchased the "secret" of the manufacture of hard porcelain from a Frenchman who had acquired this knowledge in a German porcelain factory. It was not possible however to use this formula in France until several years later when the excellent kaolin beds near Limoges were discovered. Commencing in 1771 in and near Limoges, a great number of factories were established for the manufacture of hard porcelain, thus forming the center of the French porcelain industry.

Nineteenth century French porcelain drug jars, were manufactured in huge quantities and offered for sale with a variety of decorations. Most of these typical

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The Changing Mathematics Curriculum

• **By Sister Mary of the Angels, I.H.M.**
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A great revolution in the teaching of secondary school mathematics is quietly but very effectively taking place. The new programs are emphasizing the "why" rather than the "how" in mathematics.

The author, a diocesan supervisor of mathematics, has devoted much time and study to the improvement of the mathematics curriculum.

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It did not take a Sputnik to arouse mathematicians to a need for a change in mathematics offerings at both the high school and college levels. Since mathematics as a science is an entirely different subject than it was a generation ago, the necessity for revision of curriculums has been evident for more than a decade. The invention of automatic computers, and the varied applications of mathematics to industry, to social, economic, and technological problems, has caused mathematics to step out from her main role as the handmaiden of science to other great fields of usefulness. The applications of mathematics in non-scientific fields are increasing so rapidly that it is difficult to keep pace with them. A few years ago the "newer" branches of mathematics, topology, axiomatics, probability, theory of groups, of rings, of fields, of sets, were known only to the graduate student. However, since much of what existed solely as theory, or as "pure" mathematics, or "the mathematician's delight," has become powerfully useful, colleges have been forced to change their courses. The "modernization" at the college level required a reformation at the high-school level. The 75-year old high school curriculums based on seventeenth century mathematics were indeed outmoded.

Crusaders for reform, led by mathematicians and mathematical educators, began to hammer on the hard wall of tradition to admit some of the content and spirit of the "new" mathematics. Much of the incentive to improve mathematics has come from the Commission on Mathematics of the College Entrance Examination Board, whose recommendations for contemporary mathematics programs have been widely distributed.

A few dedicated teachers, who have been aware of the metamorphosis that has taken place, have initiated new programs. The best known among these programs is probably that directed by Dr. Max Beberman of the University of Illinois Committee on School Mathematics. The UICSM project was begun in 1951. Since then it has tested its ideas with many pupils under 100 teachers throughout the United States and Hawaii. At the beginning of this school year, the Diocese of Pittsburgh introduced the program to 347 ninth-grade pupils in ten classes of varying abilities, in seven schools under eight teachers. Each Pittsburgh school has a control group so that there will be a means of comparing achievements under conventional and project programs. Of course, there will be many intangibles, in the form of understanding, concepts, and continued interest in mathematics that can never be measured. In September 1959 the course will be repeated with new groups of ninth-graders.

Other groups preparing and/or experimenting with mathematics content for secondary schools are the School Mathematics Study Group at Yale University, the Secondary School Curriculum Committee of the National Council of Teachers of Mathematics, the New York State Education Department, St. Xavier College in Chicago, and Boston College, to mention some of the better known programs.

All of these groups accent to some degree the unity of mathematics. The subject matter has generally not been compartmentalized into algebra, geometry, and trigonometry, but has been integrated into one structure. Each course has been written with the next course in mind. Furthermore, constant applications are being made to previously learned material. There is less stress on numerical work and manipulation and more on analysis. Revisions are based on the thesis that the learning of mathematics must give the power to make generalizations, abstractions, and logical organizations.

No radical changes in the content of first-year mathematics have appeared. In many ways this remains a service course for all branches of mathematics but it is presented from a different point of view. The courses I have examined deal principally with relationships, dependence, and functionality as they are formulated in modern mathematics. Both the UICSM and the College Board Mathematics Committee include inequalities in the first year. This topic usually appeared only in geometry where the inequality "axioms" were met for the first time, and except in a few isolated instances it rested there. Since the idea of inequalities is very important in higher mathematics, more and more high-school textbooks are including it.

Another concept that is basic in the new programs and is carried through the four years is that of sets. This theory, which was originated by George Cantor in the latter part of the nineteenth century (Cantor died in 1918) lies at the very foundation of mathematics, for algebra deals with sets of numbers, and geometry with sets of points. It seems strange that a topic which is one of the most unifying for mathematics and so easily understood should have been reserved for graduate students. Hilbert called the theory of sets "the most admirable fruit of the mathematical mind, and one of the highest achievements of man's intellectual processes."

Although I had studied "sets" in modern algebraic theory, I had never seen the subject listed for exposition and discussion among mathematics teachers' convention topics until 1957. At the National Council of Teachers of Mathematics convention held in Philadelphia in April of that year, Dr. E. P. Northrop of the University of Chicago gave a demonstration lecture on this topic. A whole chapter in the twenty-third yearbook of the National Council of Teachers of Mathematics published in 1957 is devoted to it. If you pick up treatises today in algebra, analysis, or geometry, the first chapter is usually a treatment of the theory of sets.

Another concept that took some of us a long time to become aware of is that algebra has the same logical structure as geometry. New programs recommend that much of algebra be presented as a postulational science based on undefined terms, defined terms, and postulates from which proofs may be drawn. In many ways algebra is superior to geometry as a vehicle for teaching deductive reasoning. Although geometry does have the advantage of being taught through figures which illustrate the things that are said and done, the theorems of algebra are generally easier. Algebra is no longer presented as a bag of tricks, with manipulation of symbols in a structureless system. There is a great difference in concept, in terminology, in symbolism. Symbolism plays such an important part in mathematics that many people, including teachers, think the symbols are the mathematics, and do not consider them as tools for developing and communicating ideas.

The new emphasis is on the "why" and not on the "what." Heretofore most algebra textbooks had absolutely no proofs. A few proved the validity of the "factor" and "remainder" theorems. Some developed a proof for mathematical induction and others proved that the square root of 2 is an irrational number. In passing, authors may have mentioned the commutative, associative, and distributive principles, but they were not referred to again. In today's mathematics these are common expressions in the vocabulary of first-year mathematics students. The fact that $a + b = b + a$, or that $ab = ba$, may seem to be mere platitudes but such principles as these help to form a mathematical system, which underlies all the familiar manipulations of algebra and provides a foundation for deriving other principles. It is the use of these which lead to the generalizations in modern algebraic theory.

In proposed revisions plane and solid geometry will be merged into a one-year course. Generally, analogous topics from solid geometry are to be treated with like topics in the plane. For example, the sphere is studied with the circle, dihedral and polyhedral angles with plane angles. Mensuration and construction problems in space are developed on an intuitive basis. This is the method used by the St. Xavier College group in their second course, "Mathematics of Magnitude." Other systems, including the Board of Regents of New York State handle it quite traditionally with a little coordinate geometry. In the proposed CBCM program six or eight theorems will lead to the Pythagorean theorem and then to analytic geometry, making it possible to prove or deduce theorems and originals by synthetic or analytic means. The UICSM course is still being taught only in their pilot schools. In September 1959 it will be ready for other schools in the project. The participating schools in the Diocese of Pittsburgh will teach this course to all students who have had the first course.

There is a recommendation in mathematical literature to at least acquaint high school students with the fact that there are other geometries besides the Euclidean one. The advent of affine, projective, elliptical, and hyperbolic geometries, and topology has brought critical examination of the axiomatic foundation of Euclid's geometry. The denial of the parallel postulate that "through a given outside point one line and only one can be drawn parallel to a given line" brought two more geometries to the fore, those of Reimann and Lobachevsky. Reimann says there is no line through a given point parallel to a given line and Lobachevsky that there is an infinity. These geometries simply point up the postulational character of Euclid's theory. It is true if and only if the postulates are true.

Recommended third-year courses include advanced algebra and trigonometry. The emphasis in the latter is on the analytic aspects, the properties of the function, including circular functions, and their relation to vectors. Time is saved for these new topics by reducing the time spent on the solution of oblique triangles by logarithms.

A study of elementary functions, polynomial, rational, exponential, logarithmic and inverse, is recommended as the major part of the work of the fourth year. The importance of the absolute value (this is begun in first year), limits, and an introduction to polynomial calculus are also stressed. The CBCM is insistent that calculus as such should not be studied in high school, but recommends that a unit on probability and statistical inference be included in this year. Statistics is no longer glorified bookkeeping but a means of testing hypotheses. As fast as the theory was developed, politics, industry, social affairs and science have taken it over for their special purposes. There is already available through the CBCM a textbook on probability and statistical inference especially prepared for fourth-year high school students. While the subject matter here described for the fourth year is likely to have been covered in the college courses taken by most teachers, it will have to be reviewed and re-studied from a truly modern viewpoint before it is presented to a class.

While teaching these new programs great stress must be placed on concepts and the precise use of language. In fact, since mathematics is a way of thinking, it must concern itself with language; for our ability to understand depends upon a well-constructed language. What errors arise from such inaccurate statements as "like signs give plus"! Another case which aptly illustrates the need for precision of language is the one "the numerator and denominator of

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Special Molecular Models as an Introduction to the Geneva Nomenclature

• By **Mary Jo Lefere *and* George E. F. Brewer**
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There are many three-dimensional molecular models on the market. Occasionally, a teacher finds that none of them meets his particular need.

The authors describe a set of special molecular models designed to meet their particular problem.

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One of the most widely used aids in the teaching of organic chemistry are the three-dimensional models of molecules. Particularly widespread is the use of the Brode-Boord-Hurd[1] and the Hirschfelder-Taylor[2] models. The latter models conform in shapes, size, and angles with X-ray difraction measurements[3] and are designed so that each centimeter represents one Angstrom unit.

Models of this type are used far beyond the undergraduate level; they are in fact used wherever organic chemists work. These models have never failed us, except during the first few class hours of Introduction to Organic Chemistry. At that time it is the student's problem to find the names of organic compounds, a purpose for which no models were designed, since these are ordinarily used to show structures.

Let us analyze the problem: the molecule itself is a three-dimensional structure; a structural formula is two-dimensional and can in turn be represented by a linear formula or systematic name. As an example, consider the hydrocarbon 2,3-dimethyl-pentane, or its delineated (one-dimensional) formula

$$CH_3CH_2CH(CH_3)CH(CH_3)CH_3.$$

The molecular models for this compound are shown in the attached illustration. It is easy even for the beginner to build the model from the name or the formula. It is, however, not so easy for the beginner to find the correct name. This process involves the projection of the three-dimensional model unto a plane, in other words, the finding of the two-dimensional formula. Depending upon the starting point and the route of this projectioning operation, various two-dimensional formulas can be evolved. The attached illustration shows three typical two-dimensional formulas of the same compound. Each one of these representations is correct, that is, from each of these, the correct three-dimensional model can be reconstructed. However, each of these representations leads to the formation of a different name, and only one of these complies with the many rules of the Geneva or IUC system of nomenclature. In case of a compound as simple as our example, only three rules of the Geneva System are involved:

a) the name of the longest carbon chain has to be stated ("—pent—" in this case);

b) the family of the compound has to be indicated ("—ane");

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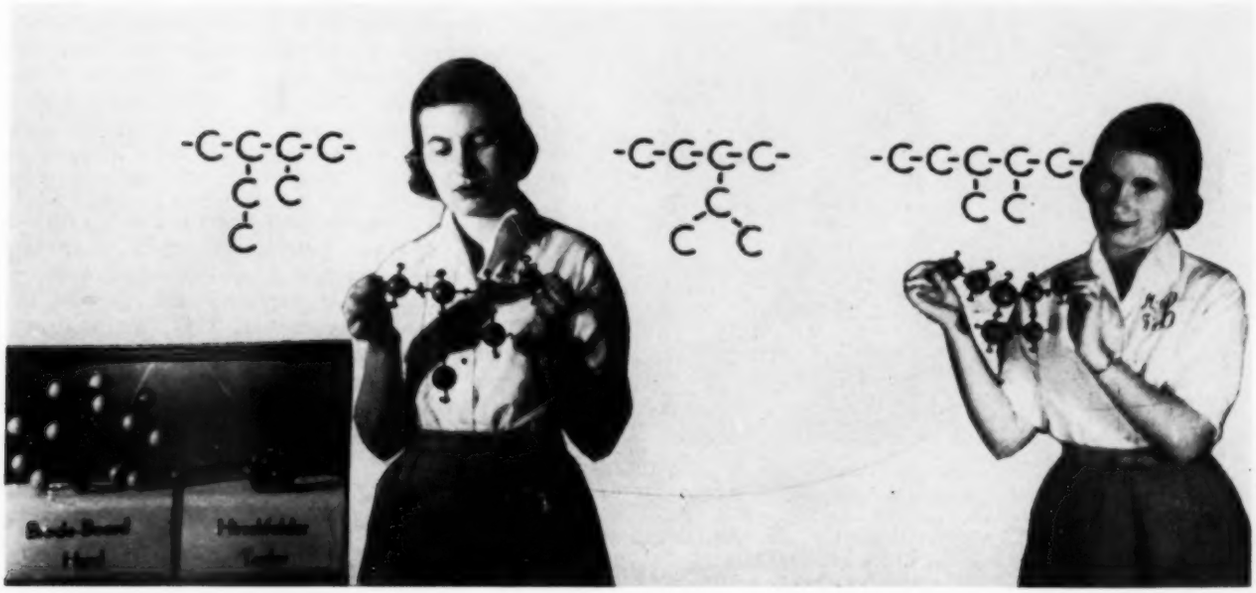

The American Tree Farm System

• By Alma Deane MacConomy
DIRECTOR, INSTRUCTIONAL MATERIALS SERVICES, EDUCATION DIVISION, AMERICAN FOREST PRODUCTS INDUSTRIES

One of the most encouraging developments in overcoming the evils of deforestation is the TREE FARM.

In addition to insuring the continuance of our wood supply, the TREE FARM *plays an important role in game conservation, flood control and in providing areas for public recreation.*

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Dotting the nation's highways and byways today are nearly 15,000 green-and-white diamond-shaped Tree Farm signs. The smaller lettering reads, "Member—American Tree Farm System." Though relatively new to the American scene, this sign symbolizes a series of revolutions in the way people have thought and acted toward the nation's forest since Virginia colonists cut the first pine logs in 1607.

SECOND GROWTH PINE. This luxurious stand of second growth southern pine will be a continuing source of profit to its owner provided it can be protected from fire and bad forest practices. By cutting selected trees in this stand, the remaining growth will mature more rapidly assuring the owner greater profit. *American Products Industries*

The colonists saw trees primarily as obstacles in the path of progress as they sought to establish homes and farms on the East Coast. But by the time lumbering had become an industry supplying lumber for homes, schools, boats and railroad ties, trees were recognized as a great economic asset in settling the raw new continent and establishing commerce. However, trees were still looked upon as an endless source of raw material available almost for the asking. Only when sawmill operators reached the Pacific Ocean did the second revolution take place. Realization dawned that the forested acres of this great new country were limited and that the transient lumber industry eventually would have to settle down and grow trees to replace those it cut.

Science entered the picture about 1900 with the establishment of the first schools of forestry. The revolutionary idea that trained men would be needed to insure the necessary regrowth had begun to germinate. As public awareness of the long range aspect of forest management grew, the question of who should be entrusted with ownership of forest land arose. The establishment of the United States Forest Service and the setting aside of millions of acres reflected public opinion that only the government with its growing staff of foresters and its freedom from industry's necessity to make a profit, could afford to fulfill the obligations of this stewardship. Gradually, however, lumber and paper companies, faced with the same tree-growing problems as the government, began to hire foresters. Slowly but steadily, forest industries, too, began to practice forestry—and at a profit! Public confidence in private ownership of forest lands rose. Tangible evidence of this popular support can be found in the establishment, chiefly through state legislative action, of organized protection against forest fires—towers, trucks and trained fire-fighting crews—for 90 per cent of all forested lands.

As the public has watched second growth forests give way to third and fourth generations of timber-producing trees, in a period when two world wars demanded wood products in unprecedented amounts, another old idea has been uprooted. This was the deeply held conviction that only virgin forests had value. Public understanding still lags behind the men in the woods on this point, but foresters and loggers know that the security of the nation's wood supply lies not in virgin timber but in the magnificent power of its forest soil to grow crop after crop of trees.

This lag in public knowledge of what was going on in the woods was one of the reasons why the forest industries started the Tree Farm program in 1941.

SELECTIVE LOGGING SCENE. Stumps in the foreground demonstrate selective logging practices at their best. Larger trees in background will be cut within a few years after they have reseeded adjacent areas. Note that stumps have been cut close to the ground eliminating needless wood waste.

K. S. Brown—American Forest Products Industries Photo

Its primary objective was to encourage more woodland owners to practice forestry. The method was simply to call attention to those woodlands where the owner was already doing a good job of it. By publicizing these model operations, both objectives were achieved. Neighbors came to see and learn from the continuing forestry demonstrations on Tree Farms and the public read about it in their newspapers and magazines.

Here is how the program operates today. A farmer or other woodland owner applies for certification as a Tree Farmer. His application is received by the Tree Farm committee in his state and a forester is assigned to inspect his woodland and report back to the committee. If his forestry practices meet the standards of the Tree Farm program, the owner receives a certificate of enrollment in the American Tree Farm System and the free roadside sign. The certificate and sign are usually presented at a public ceremony, at which the woodlands represented are dedicated to growing repeated crops of trees. The dedication is usually an outdoors community affair with picnic lunch or barbecue, speeches and forestry demonstrations. Local forest industries frequently play host.

What does the inspecting forester look for when he appraises an applicant's forest? In a sense he looks for evidence that the owner has learned all the lessons taught by the history of American forests, namely: (1) That trees are an economic asset, not a nuisance or merely an ornament to the land. A Tree Farm must be a commercial venture, producing logs or other wood products for sale or for use on the owner's property. (2) That tree harvests are being carried on in such a manner as to provide for future crops — echoing the pioneers' discovery that trees which are cut must be replaced. (3) That the land *is* privately owned. And (4) that the science of forestry is being applied according to a long range management plan, usually under the direction of a forester or in consultation with one.

It is in preparation for the inspecting forester's appraisal under point (4) that the prospective Tree Farmer will have done the most work. He will have taken every precaution to see that fire cannot start in his woods nor spread to them from adjoining land. A plowed fire break around his forest often serves the latter purpose. By removing diseased trees promptly, he prevents full scale attack by most wood-boring insects and tree diseases. Crooked trees which will produce little lumber, dead and dying trees, and trees which are too crowded to grow well will have been thinned out. This leaves a maximum of room, sunlight and good growing conditions for the younger, healthier trees which have the greatest wood-producing potential. In hardwood forests,

FIRE LINE. An effective way to halt the advance of spreading flames is to set a backfire along a fire line. The fire fighter is setting the backfire as he walks along in the furrow behind the plow. *Texas Forest Service*

fences may have been erected to keep cattle and other animals out. Grazing animals can be quite destructive by eating tomorrow's trees while they are still tender, bite-size seedlings, or by trampling them underfoot. By compacting the soil around mature trees, grazing animals can slow up the growth and reduce timber quality of today's forests. In short, a forest management plan is dedicated to the proposition that a tree can reach maximum growth in the shortest time if its enemies are held in check.

The harvesting plan referred to under point (2) above will vary by forest regions, but will always provide for trees to be left for the next harvest or for seed trees to restock the area naturally. If fire or unwise cutting in the past have left barren areas beyond the reach of wind borne seeds from mature trees, the owner may have transplanted seedlings by hand or by machine to get the tract back into full production.

FAITH IN THE FUTURE. Where seed sources have been destroyed by fires, land clearing or poor harvesting methods, it is sometimes necessary to plant trees. This may be done either by hand, as shown here, or with machines that plant up to 10 acres a day. In an average year half a million acres of land are planted to trees. About 80 percent of the planting is done by private land owners, farmers, forest industries, and investors.

American Forest Products Industries Photo

The first Tree Farm was certified in Washington state in 1941. The idea quickly spread to all forested regions under the national sponsorship of American Forest Products Industries, a non-profit educational organization with headquarters in Washington, D. C. It was created and is supported by lumber, paper, plywood and other branches of the forest industries. Alabama was the first state in which an organized Tree Farm certification program was established. Today AFPI operates the program through state industry committees, usually with the close cooperation of the state forester and other interested forestry agencies, in every state except Kansas and Nebraska. There are 14,355 Tree Farms ranging in size from three acres to 800,000 acres each. Together they total 48,824,244 acres.

If it were possible to assemble the nation's Tree Farmers and ask them to answer roll call by giving their occupation and a one-sentence statement of what Tree Farming means to them, the result would be a rich slice of Americana. Dentists, retired school teachers, beauty queens, clergymen and small business men of many kinds would speak up as well as a larger number of farmers and owners of lumber companies, paper companies, and other forest industries. To one, the cash crops from his well-managed woodland means a college education for his son; to another his own retirement income. To the forest industries, a Tree Farm is a self-renewing source of raw material to keep their mills operating indefinitely. To the farmer it may mean posts and poles for fences, plenty of fuelwood, perhaps lumber for a new barn. All Tree Farmers report a deep sense of satisfaction in the knowledge that they are good stewards of the land and that they will pass it on in better shape than they found it.

Having noted the way in which the Tree Farm program reflects the evolving pattern of forestry in the United States, brings us to the question of the current status of that evolution. What are the issues and what part does the Tree Farm program play in resolving them? Probably the question of determining the best use of each acre of forest land is one of the most vital. Some feel that certain areas must be set aside for recreational use of burgeoning urban populations; others, deeply concerned with the water problem, urge that forested watersheds be left alone to insure maximum control of runoff from rain and melting snow; sportsmen, worried about maintaining adequate stocks of fish and herds of deer and other game animals, seek to provide private fishing and hunting preserves. And, of course, wood-using industries feel the necessity of getting every possible acre into maximum production in order to meet the anticipated needs of a rapidly expanding population.

While the debate goes on, several pertinent developments have recently been observed on Tree Farms. A national survey revealed that 90 per cent of all industry forests, most of them Tree Farms, are open to the public for hunting, fishing, hiking, camping, and other forms of recreation. By growing continuous crops of trees, Tree Farmers keep ground cover on their woodlands most of the time. This results in good soil-holding and water-holding capacity. Thus, many tree-covered watersheds are being successfully used for the simultaneous production of wood and water. Likewise, the repeated cutting of trees, provides more homes and food for game birds and animals. As mature trees are harvested, sunny places are opened up in the shade

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The Conservation Concept . . .

Its Significance for a Free Society

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At no time in our history has the conservation of our national resources been a more crucial matter. During World Wars I and II we used our resources lavishly. The period in which we are now living is dominated by a bitter and intense conflict between communism and the democratic way of life. The scope of this conflict is worldwide, and we are again using up our basic raw materials at an unprecedented rate by spending approximately half of our federal revenues on a "cold war." By effecting such a prodigal use of our natural wealth, our enemies may achieve an ultimate collapse of our whole economy.

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A Basic Weakness

Our opponents frequently affirm that the basic weakness of a democracy lies somewhere in its economic system. Many of our realists would agree. Our leaders recognize that, in the last analysis, democracy will win or lose on the basis of its capacity to find answers to the eternal problems of subsistence, problems which our ancestors faced none too successfully, and which today are loaded with critical overtones for the entire world. This problem can no longer be glossed over. Regardless of what a democracy may do in the cultural and human relations areas, if it fails to secure renewable resources such as water, soil, animals, forests, grasses, and other vegetation, as well as the non-renewable minerals, it will most certainly go down to defeat.

If, then, we are concerned with the welfare of democratic man and the preservation of his culture for posterity, there is no kind of education more significant than that which seeks to make the average American intelligent about the conservation of his natural wealth and that of the entire free world.

Unfortunately, conservation education in America and throughout the world is meager, sporadic, and often sterile in character. People in rural areas see the necessity and significance of conservation all about them, but pupils in urban centers know about the subject only if it is systematically brought to their attention. In the United States it has been quite possible to go up the educational ladder through college and not be exposed to those basic conservation ideas so vital to our welfare and our future.

Americans, complaining of inflated food prices, have little understanding of the food problem confronting the great majority of people in the world today. The Director of the Food and Agricultural Division of the Economic Co-operation Administration has pointed out that the countries in which the average per capita food consumption even begins to approach adequate standards are the United States, Canada, Argentina, Australia, New Zealand, Denmark, Sweden, and Switzerland. The remaining 85% of the world's population exists on diets which range from a barely tolerable subsistence to literally slow starvation. The issues of conservation, then, are the issues of life itself, and the survival and unification of the free world dictate that these issues must become a part of the general education of all peoples.

Conservation and Science

At the present rate of resource-use, neither the United States nor most of the other nations can long support their present populations on a high plane of civilized living without renewed emphasis on conservation. Our best leadership recognizes that, however science can assist natural processes, it cannot altogether replace them. Science and conservation must be thought of as having an essential integration rather than as separate entities.

Through applied science such conservation activities necessary for farming, ranching, fishing, mining, manufacturing, and lumbering can be interrelated. Until such integration, based on the interdependence of soil, water, minerals, plants, animals, and man, becomes more extensive and effective, there will be dust bowls, silted reservoirs, polluted streams, and other consequences of ignorance and indifference.

Reclamation

To what extent can man, through science and technology help nature in restoring the ravages of man's destructive and wasteful exploitation of land and other resources? Since the number of people affected in some measure by the conservation activities of modern science—medicine, sanitation, farming, and industrial technology, etc.—comprise the great majority, it is conceivable that this aspect of the subject has not been sufficiently considered.

By knowing and respecting nature through the applications of science, man can immeasurably improve his lot. Such potentialities as lie in a thorough exploration of the sea for plankton and marine life, in a more scientific utilization of the land, and in a more systematic application of genetics to improve and to develop new strains of fish, fowl, and cattle, need exhaustive exploration. Algae, one-celled plants often viewed as scum on ponds, absorb sunlight and by this

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Opportunities in Atomic Science

• By Rev. Zachary O'Friel, O.F.M.
DEAN, SCHOOL OF ARTS AND SCIENCES, ST. BONAVENTURE UNIVERSITY

This article is taken from a paper presented to the Pittsburgh Diocesan Science and Mathematics Teachers' Institute Day, February 7, 1957.

After expressing his gratitude to the Sisters, his former teachers, the author discussed the challenge and opportunities offered to youth by the new frontiers of science.

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In 1490, there was a great debate raging all over Europe, but especially in Spain. A visionary, with his head in the clouds, was not satisfied with earning a living as an ordinary sailor. He wanted his own ships to prove, of all things, that the earth was round. He had the fantastic idea that by sailing westward he would be able to reach the fabulous wealth of the Indies, as well as the legendary lands of Cathay and the realms of "Prester John." Now as everyone at that time plainly knew, the earth was flat, and if you sailed too far out in the ocean you would soon fall off the edge. Yet, spurred on by the convictions that it was his mission to bring the faith of Christ to the pagans of these far off lands, and using the old argument of money to be gained by investors, Christopher Columbus gained his point and finally set sail toward the west. As you know he landed on one of the small islands in the present day Carribean Sea, and died years later not fully realizing that he had not reached India, but instead had discovered a continent, a New World.

Between the 1500's and the 1900's, the efforts of young men were spent exploring and settling that new world. A fierce and sometimes vicious frontier life was the order of the day. Anyone who wanted adventure and fortune, betook himself to some place where gold had been found, or some other precious metal lay hidden in the ground. Others seeing that the quick road to vast wealth lay in civilizing pursuits began various kinds of business, with the result that soon towns grew up, formed themselves into states, and today the flag of this beloved land carries proudly the 50 white stars on her field of blue.

The young men of today, ask themselves: where are the new worlds to conquer? How far away will I have to go to make my fortune? Whence lies the modern frontiers? The answer lies in one of the tiniest objects to be fashioned from the hand of God: the atom. We have all seen the glory of God as it shines forth in the firmament of a star-studded night sky. But did you ever know that it is possible to predict the actual path in which some of those heavenly bodies, especially the planets of our own solar system, actually move? Yes, it is possible to sit down and calculate mathematically just how and when a certain planet will appear in the sky. The remarkable thing is this: the very same mathematical equations which give the predicted paths of the planets can also be applied to the tiniest atom . . . and they work to a good approximation. As you know: an atom consists of a heavy hard core called a nucleus which is positively charged. Around this heavy core spins a tiny particle called an electron. If we use the mathematics which predicts the orbit of a planet spinning around the sun, we can actually predict the orbit of an electron about the nucleus and even calculate its energy.

Here then lies the frontiers of the future. To the young men and women in school, the future of science in our own country is unlimited, and the opportunities in the fields of atomic energy are boundless. Not only this, but they are needed; Catholics are needed. Men blessed with the true Faith which Christ brought to earth from Heaven 2000 years ago are needed to be the guiding lights toward the right and lawful usage of this hidden power which God has stored in the tiniest object of His creation: the atom.

When nuclear fission (that the Uranium atom would split into two unequal portions with a tremendous energy release) was discovered in 1939 the physicists of the world immediately realized that here was another powerful force which God had given to man. Previously man used his intelligence to harness the forces of coal, oil and waterpower for electricity. But each of these was limited by the available supplies on hand. With the atom, everything changed. Every substance on earth was made of such atoms. Here was something so abundant that it could never be exhausted. For a quarter inch cube of uranium can replace 10,000,000 cubic feet of gas, four railroad cars of coal or two tank cars of oil. Let it be to the credit of the scientists who first learned of the possibilities locked up in the hard core of the atomic nucleus, that they knew of the A-bomb as well as the peaceful applications at that same time. Had the discovery of fission come at any time but at the start of World War II the chances are that all attention would have been focused on the peaceful uses, and man's first boast would have been an atomic power plant, rather than a bomb at Hiroshima.

The peaceful uses are unlimited. There are new fields opening daily for example in medicine, where it is possible to feed a patient a pinch of atomic salt and by means of suitable detecting units to trace the whole process of how salt is used by the human body. There are possibilities being now investigated whereby some radioactive minerals can be introduced into the body to destroy the harmful and damaging spread of cancer. The doctors who study the problems of the human blood stream are able to inject a small quantity of radioactive elements into a vein and study the workings

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Saliva and Salivary Glands

• By F. J. Draus, Ph.D.
ASST. PROF. OF BIOCHEMISTRY, SCHOOL OF DENTISTRY, UNIVERSITY OF PITTSBURGH

Recent studies have provided much information on the composition and the multiple role of saliva in body functions.

Teachers of biology and chemistry will find much useful information in this article.

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Of all the body fluids, the body fluid which we most easily accept as a matter of fact to be present is saliva. Yet this fluid is not as simple a mixture as one might assume.

Saliva is a secretion of three pairs of glands, the parotid, the submaxillary and the sublingual. The parotid gland, the largest of the glands, is wedge-shaped and is located towards the back and lower portion of the external ear. The submaxillary gland, which is variable in size, is ovoid in shape and is located on the floor of the mouth. The sublingual gland, the smallest of the glands, is an elongated mass located toward the side and below the tongue. Whole saliva is a secretion of the mixture of these glands. The glands contribute their secretions in a resting stage in the order of 70% from the submaxillary, 25% from the parotid and 5% from the sublingual. These proportions of course change as various stimuli are applied.

The fluid discharged from the parotid gland is usually serous, that is, a watery fluid, whereas that of the submaxillary and sublingual glands are both serous and mucous. It is the fluid from these glands which gives saliva its viscosity and "slipperiness," both due to the presence of the glycoprotein, mucin.

The functions of saliva are to lubricate food for swallowing; to dissolve substances which stimulate the taste buds; to aid in mechanically cleansing the mouth, thus preventing sordid collections and dental caries; to moisten the mouth, especially for speech; perhaps to help produce thirst, when the amount of secretion is diminished by dehydration or hemorrhage; to digest starch to maltose by means of ptyalin.

The production of saliva in general is by secretion and not by excretion. The normal secretion of saliva in man is between 1 liter and 1.5 liter per day[1], whereas in cows it is in the order of 60 liters per day and in horses 40 liters per day. With continuous stimulation the maximum amount of saliva produced by man has been 15 liters per day.

The secretion of saliva is influenced by psychic, mechanical and chemical stimuli. Everyone is familiar with the "watering of the mouth," brought about by the anticipation or sight of food. The presence of food in the mouth and the act of chewing, mechanical stimulation also increases the flow of saliva. There is no evidence for hormonal control of stimulation even though conditions of mental stress diminish the flow rate. The salivary glands are controlled by a center in the medullary portion of the brain. The innervations are both parasympathetic and sympathetic.

The determination and comparison of the total composition of saliva is difficult for three major reasons: 1) the saliva is a mixture of the secretion of the three glands, each possibly contributing a different amount; 2) the suspended material makes it difficult to determine what is exactly present; 3) different methods of stimulation and collection may influence the results.

In general, saliva contains between 99.4-99.5% water, the remainder being solid material. The normal pH is in the range of 5.0-8.0, the average taken as 7.2. The specific gravity ranges from 1.000 up to 1.020 with the usual values being from 1.004 to 1.012.

The principal inorganic constituents in saliva are presented in Table 1.[2]

TABLE I

INORGANIC COMPOSITION OF HUMAN SALIVA

(Mg. per cent)

Ash	225	Cl	50.0-75.0
Ca	5.2-12.1	S	7.6
P	13.6-15.5	Mg	0.7-1.3
Na	18.9-70.0	F	0.01-0.02
K	55.9-71.4	CO_2 capacity (mg/cc)	8.1-8.9

The concentration of the inorganic ions in saliva may be an indication of the overall health of the person. These ions are probably correlated with the blood levels. The salivary concentration of sodium and potassium changes in pathological conditions, as do these ions in the blood. The maintenance of definite calcium and phosphorus levels in the body are necessary for the health of bone and teeth. Low calcium values may result in a re-solution of the tooth surface, providing conditions for decay. The addition of any material which tends to precipitate the calcium or phosphorus should be avoided since these precipitates tend to adhere to the tooth surface and result in the formation of calculus, more commonly known as tartar. The carbon dioxide capacity is an indication of the buffer capacity of saliva. The carbonic acid-bicarbonate buffer is the principal buffer system in the body. In the mouth it is responsible for maintaining the proper pH so as to minimize the precipitation of calcium and phosphorus, and the re-solution of the tooth surface.

The principal organic constituent in saliva is mucin. Mucin is a complex organic substance composed of both protein and carbohydrate. The exact structure of the mucoid has not been elucidated, but the carbohydrate portion has been shown to contain acetylated glucosamine and, possibly, glucuronic or galacturonic acid.

Mucin is present in saliva as an alkaline salt. It has an isoelectric point of 4.70 and can be precipitated by

the addition of acid. It is believed that the precipitation of the mucoid is also necessary for the formation of tartar on the teeth. A person ingesting an acid food which lowers the pH below the isoelectric point would precipitate the mucoid which, in the presence of a precipitate of an insoluble calcium salt, could form tartar.

Other than the carbohydrate found in the mucin there is relatively little free carbohydrate found in saliva.

In addition to the mucoid, saliva contains enzymes, free amino acids, vitamins and urea.

The functionally significant enzymes found in saliva[3] are ptyalin, carbonic anhydrase, lysozyme and hyaluronidase.

Ptyalin is an alpha amylase which acts on starches to liquefy them and to produce dextrins and some maltose in the mouth. This is the only significant function performed by saliva. The amylase activity in a person's saliva remains fairly constant throughout life, the average concentration being 100 units per ml.

Carbonic anhydrase catalyzes the liberation of carbon dioxide from carbonic acid, and is important in the buffering capacity of saliva.

Hyaluronidase is the enzyme which depolymerizes and hydrolyzes the intercellular substance(hyaluronic acid. It has been found in concentrations from 0.00 to 53.0 units per 100 ml. of saliva.

Lysozyme is a bacteriolytic substance which gives saliva some degree of resistance to growth of harmful bacterial organisms. It has been found in concentrations ranging from 0.37 to 62.50 units per 100 ml. of saliva.

In addition to the above mentioned enzymes a number of others have been shown to be present and are tabulated in Table II.[4]

TABLE II

ENZYMES FOUND IN MIXED SALIVA

(units/100 ml.)

acid phosphatase	0.5-13.0	total esterase	0.10-7.50
alkaline phosphatase	0.025-1.11	cholinesterase	0.00-0.221
D-galactosidase	0.4-2.76	lipase	0.20-2.70
D-glucuronidase	0.00-0.53	aryl sulfatase	0.025-0.465

A number of free amino acids have been shown by paper chromatography[5] to be present in saliva. These include glutamic acid, aspartic acid, glycine, alanine, methionine (sulfoxide), arginine, leucine, lysine, phenylalanine, taurine, tyrosine, valine, and proline. It is possible that the free amino acids could arise from the breakdown of the protein fraction of the mucoid.

The vitamins which have been found to be present in saliva[6] are thiamine, riboflavin, nicotinic acid, pyridoxin, pantothenic acid, folic acid, biotin, ascorbic acid (vit. C) and vitamin K. The amounts of these vitamins in saliva may be an indication of the nutritional condition of the person. They may also determine the type of microorganisms present in the mouth, since these microorganisms have specific growth requirements.

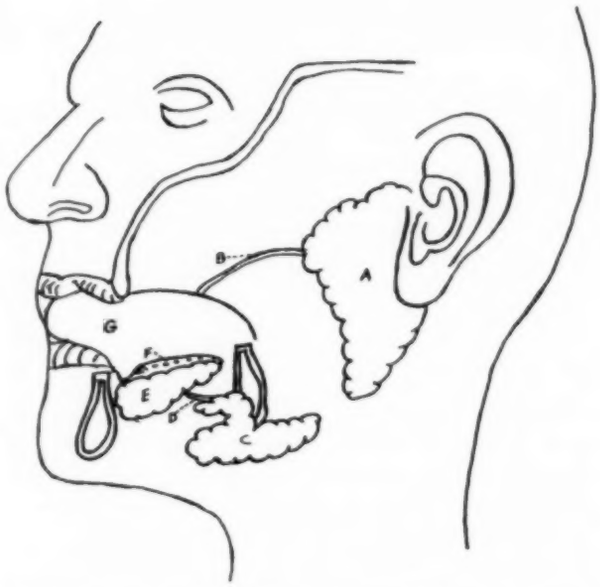

FIG. 1. Sagittal Section of Head. A, parotid gland; B, parotid duct; C, submaxillary gland; D, submaxillary duct; E, sublingual gland; F, sublingual plicae; G, tongue.

There are indications of a hormone-like material in saliva, but the exact nature of this material has not been established. Generally, hormones are secreted into the blood stream by means of ductless glands. Since the salivary glands secrete their fluids into the oral cavity by means of ducts, by definition the presence of hormones in the saliva originating in salivary glands is not possible.

A material having hormonal like activity has been isolated from saliva[7]. This material, called parotin, promotes tooth growth in rats and lowers Ca levels in rabbits. It also shows the property of lowering the blood pressure in experimental animals.

The salivary glands seem to play a role in regulating some of the glands in the endocrine system. If the parotid and submaxillary glands are removed from animals, the parathyroids, thyroid and pituitary glands are affected. These glands develop to only half of the weight of glands in control animals and distinct histological changes are noted. These glands play a role in controlling the calcium and phosphate requirements of the body. Since a proper calcium and phosphate ratio is necessary for healthy tooth development the possibility of an interrelationship could be expected. The exact mechanism by which the salivary gland affects the endocrine system is not known.

The removal of the salivary glands also causes distinct changes in certain sex gland functions. The corpus luteum, which produces progestrone in the female, and the testes, which produce the male sex hormones, become atrophied.

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Fossil Man and Evolution

• **By A. Kenneth Hesselberg, Ph.D.,** *(Catholic University)*
CHAIRMAN, DEPARTMENT OF POLITICAL SCIENCE, DUQUESNE UNIVERSITY, PITTSBURGH, PENNSYLVANIA

The teaching authority of the Church does not forbid that in conformity with the present state of human sciences and sacred theology research and discussions on the part of men experienced in both fields take place with regard to the doctrine of evolution in as far as it inquires into the origin of the human body as coming from pre-existent and living matter — for Catholic Faith obliges us to hold that souls are immediately created by God. However, this must be done in such a way that reasons for both opinions, that is those favorable and unfavorable to evolution, be weighed and judged with the necessary seriousness, moderation and measure and provided that all are prepared to submit to the judgment of the Church to whom Christ has given the mission of interpreting authentically the Sacred Scripture and of defending dogmas of faith.

HUMANI GENERIS.

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It appears probable, on the basis of scientific evidence mounting yearly, that man's body has evolved from pre-existing organic matter; or, in plainer and more precise language, that man, so far as his body is concerned, has very probably latterly descended or ascended (it matters not which) from certain apelike ancestors long since extinct. This is not to say or imply that "man is nothing but an ape with a few extra tricks"; for enormous is the gulf which separates even the lowest species of humankind from the highest of the other primates. But this great gulf is a mental and spiritual one. So far as man's corporal origins are concerned it is becoming increasingly clear that these are involved in that great evolutionary pattern which has involved all forms of organic matter. Scientific evidence to date to support this assumption, based largely upon fossil anatomical comparisons, while not by any means conclusive, is very strongly compelling. This fossil evidence is also being increasingly corroborated by the newer sciences of embryology, genetics, and geology[1].

Needless to say, the theory of evolution which rests upon this mass of evidence must be dealt with in terms of what it seeks to explain, that is, the data themselves. The time has long passed when it might be disposed of or freely rejected solely on dialectical grounds or any mode of purely a priori reasoning. The heart of the matter is that the earlier scientific postulates of special creation and the immutability of each organic species no longer serve to explain the existing facts. In their place have been substituted the newer hypotheses of transformism and the mutability of organic species. Empirical science has now vast evidence to support that mutations do occur in plants and animals, that species do change in time, and that an earlier species can be transformed in the course of time into a new one quite different from the earlier one. Indeed the botanical and biological scientist is often baffled and perplexed by the very complexity and mutability of his data. The question of what constitute species and genera in the botanical and animal kingdoms is a difficult one. The problem is no less simple in the case of fossil man.

The question might be asked at this point: what kind of a record do we have of fossil man? The answer quite simply is that we have a record consisting mainly of bones and teeth, flint tools and implements, unearthed at varying levels of geological strata[2]. At first impression not very promising perhaps, nevertheless it is quite remarkable what the paleontologist and comparative anatomist have been able to glean from it. A further question might be asked: what does this record reveal as a pattern? In answer we suggest that, generally and rather paradoxically speaking, the fossil record reveals that the farther back we go in the Pleistocene period of geological time the more apelike appears man and the more manlike appear certain anthropoid apes. Upon this paradox hinges the crux of our problem of the probable evolutionary origin of man. Such strikingly close similarities in physical structure, the scientists contend, are only to be ex-

(Continued on Page 58)

TABLE I.
RELATIVE CHRONOLOGY

I	HOLOCENE — Contemporary Period	*Last 25,000 Years*
II	PLEISTOCENE	*From 25,000 - 1,000,000 Years Back*
	1. UPPER PLEISTOCENE *(About 70,000 years back)*	Homo sapiens Cro-Magnon man Neanderthal man
	2. MIDDLE PLEISTOCENE *(About 500,000 years back)*	Sinanthropus (Peking man) Pithecanthropus Erectus (Java man) Heidelberg man
	3. LOWER PLEISTOCENE	Australopithecus
III	PLIOCENE	

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Fossil Man and Evolution

(Continued from Page 55)

plained by the assumption of a genetic link between the two which goes back possibly to a common ancestral stock of extinct Miocene and Pliocene apes. At this date the earliest assumed possible common ancestor of apes and men is the East African Miocene ape called Proconsul which lived about 25 million years ago. Until very recently only the various types of late Miocene and early Pliocene apes named Dryopithecus were thought to continue the ancestral line leading to Pithecanthropus—or the Java ape-man, the earliest known human who lived about a half million years ago. Except for the controversial Australopitheci, which lived about 750,000 years ago and whose special place in the hominid line has not yet been definitely determined, a huge gap remained between Proconsul and Pithecanthropus. This huge gap has now been bridged by the recent discovery of a complete skeleton of Oreopithecus which lived during the Pliocene period about 10 million years ago[3]. This creature marks a considerable advance over Proconsul in the human direction.

It remains for future studies to describe the skeletal structure of Oreopithecus, but as for Proconsul and Dryopithecus, their fossil remains show that they were more generalized in their physical structures, particularly in their limbs and teeth, than are contemporary apes. The structures of arm, leg and foot bones strongly suggest that these Miocene and Pliocene apes could walk erect for periods of time without the need of arm support, unlike contemporary species. Of contemporary species, only the gibbon is accustomed to walk erect when on the ground, using his long arms as balancers. The jaws and teeth of these early species also reveal a lack of certain specializations, and also lack the so-called "simian shelf" characteristic of contemporary species[4]. Scientists are inclined therefore to look upon contemporary species of anthropoid apes as terminal products of an evolutionary radiation which began millions of years ago in early Miocene times, during which those early species which were to culminate in man gradually diverged from those which have become the terminal products of that process.

Fossil Apes or Fossil Men?

We might here ask ourselves: how far can science go in distinguishing fossil apes from fossil men? What happens when a fossil skeleton is discovered which blends human and simian characteristics in a baffling array? Comparative anatomists and vertebrate paleontologists have become exceedingly skilled in making skeletal comparisons of man with the other primates; but the discovery in ever-increasing numbers of intermediate fossil forms now give even the skilled anatomist pause. Comparisons of the fossil limbs and lower parts of the skeleton reveal much, but of themselves have not as yet provided a safe and sure index in distinguishing fossil apes from fossil men. In certain instances ape and man may be matched bone for bone, muscle for muscle, organ for organ. Comparisons of the teeth also reveal much, but of themselves do not provide an unerring guide. Indeed, so close in almost every respect, in certain instances, are the skeletal structures of ape and man that one of the leading physical anthropologists in the field, Sir Wilfred Le Gros Clark, has been led to remark: "Probably the differentiation of man from ape will ultimately have to rest on a functional rather than on an anatomical basis, the criterion of humanity being the ability to speak and to make tools."[5]

Skull Structure—Most Reliable Criterion

Are we then left without any certain skeletal criteria for distinguishing fossil apes from fossil men? In the absence of other physical criteria, such as flint tools and implements and the evidence of fire-hearths, which might settle the issue, we are compelled to admit that, in certain fossil instances, we are unable to tell with any degree of finality whether we are dealing with apes or men. We know only that, working backward in his history, at a certain period the size and shape of fossil man's brain approaches the proportions of an ape's, which brings us to an essential point, in which all scientists so far are agreed, namely, that, physically speaking, it has been the evolution and development of man's brain that has differentiated him from the other primates. The progressive development of the human brain has caused changes in the skull structure which more and more clearly in the course of time mark man off from his primate brethren. Since the size of the brain-case is of such paramount importance, the scientist, upon the discovery of a fossil skull, would probably first of all have an endocranial cast made and the range reported, in accordance with present criteria, would vary most probably anywhere from 450 to 1600 cubic centimeters, which are the present polar ranges for anthropoid apes and humans. So far the only distinctive feature of the human brain is its size, shape, and complexity in proportional relation to the rest of the body. The skull-vault is much higher in modern man than it is in the ape: the greater development of the human brain revealing itself chiefly in the frontal and parietal regions which give the skull of modern man a high forehead and more rounded effect on top where the ape's is generally flattened. But we must observe also that the skulls of the known earlier prehistoric men are generally flattened. Characteristic also of the ape's skull, and instantly recognizable, are the large supraorbital tori, or eyebrow ridges. But these are characteristic also of prehistoric humans, as for example, the Pithecanthropians and Neanderthalians, and so of themselves do not distinguish apes from men.

The progressive enlargement of his brain has given man one of his most distinctive characteristics, a more or less vertical face. Here the scientist would measure the facial angle. In the anthropoid apes and in prehistoric man prognathism is very pronounced. That is to say, the lower part of the face projects considerably beyond the upper part. Measurement reveals that the facial angle in a gorilla is 32 degrees; in a chimpanzee 39 degrees; in Paranthropus—one of the Australopitheci—47 degrees; in Pithecanthropus Pekinensis—

or Peking man—56 degrees; in Neanderthal man 61 degrees; in Cro-Magnon man 65 degrees; in Homo sapiens—our own species—72 degrees[6].

The progressive enlargement of the human brain has also caused a gradual reduction in size of the snout region. Obviously, with an increasingly greater dependence on brain the olfactory region, that is, the apparatus of smell in all of its size and complexity, gradually diminished. Also with the decreasing importance of the masticatory, or chewing apparatus, the mandible or lower jaw and teeth diminished in size. Thus the scientist would next examine the mandible, or lower jaw and teeth, inasmuch as even a cursory glance reveals so much. In the apes the mandible is massive and heavy and there is considerable chin recession, whereas in Neanthropians and modern humans, the size of the mandible is much smaller and there is chin eminence. This latter feature, however, is not characteristic of earlier prehistoric humans who in common with the apes possessed massive lower jaws and receding chins. Further, the dental arch of most anthropoid apes is U-shaped whereas the modern human dental arch is parabolic. But the dental arches of the Australopithecinae, which lived more than a half million years ago, are hardly distinguishable from those of modern humans. In the apes the canine teeth project sharply above the level of the other teeth, whereas in modern humans the teeth are usually rather level, the canine teeth projecting only slightly above the others. But there is no canine projection in the mandible of Heidelberg man who lived more than a half million years ago. There is, however, some canine projection in Pithecanthropus erectus, or Java man. In the apes also there exists a diastema, or gap between the canine and incisor teeth to permit the closing of the jaws which is lacking in modern humans. This diastema is, however, present to some degree in Pithecanthropus.

Concluding this very general examination of the skull, the scientist would probably turn to the foramen magnum, or opening in the base of the skull through which the spinal cord passes, and the occipital condyles by means of which the skull connects with the neck region. With the gradual acquisition of an erect posture and a vertical backbone, the foramen magnum moved gradually from the rear of the skull where it exists in an ape towards the basal or underneath part where in man it has become pretty nearly centralized. From the position of the foramen magnum alone the scientist can get a pretty good indication as to whether the creature walked upright or needed frontal support. It is therefore quite obvious, from what we have seen, that an examination of the fossil skull alone reveals much about the creature.

These are among the principal scientific criteria whereby apes are distinguished physically from men. But distinguishing criteria which gradually fail the farther back we go in time (in the Pleistocene period) very patently reveal their limitations; and yet strangely and most cogently withal support the theory of human evolution. Particularly is this so in the case of the Australopithecinae—a group of little creatures, which probably weighed on the average only 50 lbs., and lived during the early or middle Pleistocene period, most probably about 750,000 years ago. These little creatures walked upright and combined human and simian skeletal features in a puzzling array. The pelvic and limb bones and the position of the foramen magnum establish their erect posture; the brain-case is set higher in relation to the upper part of the face than it is in the anthropoid apes; the orbital region and its relation to the zygomatic arch is remarkably human; the teeth and dental arcade are amazingly human; but the brain-case in size and the skull contours are rather those of an ape than of a human, ranging in cranial capacity from 400 to 650 cc.; the latter figure exceeding the capacity of any known ape, but still below what is thought to be the human range; and the prognathism is so pronounced as to amount to a veritable muzzle. Are we dealing here with a manlike ape or an apelike man? On this question there still prevails considerable latitude of opinion[7]. No deliberately manufactured artifacts have yet been found, nor any undisputed evidence of the use of fire; but there is some evidence that these creatures used the thigh-bones of large animals to bash in the skulls of baboons on which they fed. Thus there is some evidence that Australopithecus may have been a tool-user, but none so far that this creature was a systematic tool-maker. Great is the gulf between ape and modern man; but highly tenuous is the dividing line between fossil ape and fossil man where the criteria rest solely on comparative anatomy.

Science is on far surer ground in dealing with the Pithecanthropi[7]. Pithecanthropus erectus, or the Java ape man, as he is familiarly called, is the earliest definitely known human who lived during the middle Pleistocene or about 500,000 years ago. His remains have been found in Java and China. The human remains found in China have scientifically been labelled Sinanthropus, to distinguish them from their Javan counterpart, but the differences between the two are slight and so usually both are referred to as Pithecanthropus. Of the Javan Pithecanthropus we have only the skulls and thigh-bones (femora). The thigh-bones indicate an erect posture—as erect as yours and mine. The skull fragments which have been both scientifically and artfully put together reveal the absence of a forehead and a low skull-vault indicating a brain far smaller than modern man's. There are also enormous apelike supraorbital ridges (i.e., eyebrow ridges). Endocranial casts reveal the size of the brain-case to have been approximately 900 cubic centimeters. The endocranial capacity of modern man varies from approximately 1350-1500 cc. The endocranial capacity of any known great ape rarely exceeds 600 cc.

The bone fragments of Sinanthropus—or Peking man as he is sometimes called—furnish more extensive information. Here we have portions of skulls belonging to at least 14 individuals, and fragments of jaws and teeth belonging to at least 3 dozen more individuals, as well as the shafts of 2 thigh-bones, an upper arm-bone, a collar-bone, and one of the wrist-bones. And what is equally important, we have evidence of fire-hearths and cutting tools of stone of by no means

a primitive level. As a matter of fact, the stone culture of Peking man was on a higher level than has existed in modern times among the primitive Tasmanians and Australian aborigines. What is rather disturbing, however, is the evidence that Peking man probably practised cannabilism, as in every instance the skulls were broken open from below in such a fashion as to indicate the purpose was to extract the brain. We note in this connection, however, that the practise of cannabilism has not by any means been restricted to primitive Sinanthropus, as the much later Neanderthal men—at least the early specimens among them—have also left evidence to indicate that they likewise had a fond predilection for human brain. And of course it is well known that the practise of cannabilism in varying forms still persists among certain primitive peoples of the world. Endocranial casts reveal that Sinanthropus had a brain capacity which varied from about 850 to 1300 cc., with an average of about 1075 cc., which is still considerably below that of modern humans, but is somewhat higher than that of his Javan counterpart, suggesting that the latter is the more primitive of the two. The limitations of space do not permit treatment of middle Pleistocene European human fossil remains, which are extremely scanty at best, consisting mainly of the Heidelberg mandible, the Swanscombe skull, and the controversial Piltdown man whose jawbone was discovered to be fraudulent. Improved scientific techniques make it unlikely that any further frauds of that kind will be perpetrated.

To date the best available evidence establishes that from the third interglacial until well after the middle of the fourth glaciation—or ranging probably anywhere from 35,000 to 70,000 years ago—Europe and the Middle East were populated by a strange little group known as Neanderthals, named after the Neanderthal valley in Germany where they were first discovered. Up until the present time about a hundred complete or partial skeletons have been unearthed, more than all the earlier Pleistocene specimens put together. As a consequence we know considerable about these peoples. Also found with the remains were great numbers of artifacts which prove their culture to have been what scientists call Mousterian to distinguish it from earlier and later cultures. There is also suffiicient evidence to indicate that they buried their dead, had at least rudimentary religious beliefs, and that probably the earlier among them practised cannabilism.

What does the skeletal structure of Neanderthal man reveal? We note first of all that he averaged 5 feet 4 inches in height (we are speaking now only of Classic Neanderthal man). He was barrel-chested, big-headed, short-necked, and rather stooped in posture. He possessed slightly curved thigh-bones, and the structure of his ankle-bones reveals that he must have spent considerable time in a squatting position. A glance at his massive skull impresses us with its apelike appearance. The skull possesses heavy supraorbital ridges, the forehead is receding and the skull-vault low. The size of the brain, however, is very large and averages nearly 1600 cc. in the male specimens. Although the size of the brain-case is within the modern range (indeed exceeds it), it is characterized by a protuding occiput and lacks the rounded contours of modern man in this region; and the frontal region of the brain, which is thought to be important in the development of the highest mental faculties, is much less developed than it is in our own species—Homo Sapiens. The face reveals considerable prognathism, and is very large and long in proportion to the brain-case. The eye sockets are large and round and the nose-opening broad. The teeth are large and powerful and set within a massive jaw. Some of the molar teeth retain some apelike features; but the dental pattern is on the whole essentially human. There is considerable chin recession; and the forearm and the shin-bones are considerably shorter than modern man's.

Passing now to other significant items, there is extensive evidence that Neanderthal man lived in or near the mouths of caves, and that his stock of tools was well cared for and not inferior to any great degree to those of his successors, the Neanthropes. There is evidence he possessed considerable skill in butchering animals; and all in all it is quite possible that his intellectual level was higher than the shape of his skull would suggest. Further, there is, as we have mentioned, incontestable evidence that Neanderthal man buried his dead with great attention to ritualistic detail, providing them with their tools, weapons and food, and laying them out in very carefully arranged positions. It has been pretty much a mystery what happened to Neanderthal man in Europe: he appears to have disappeared rather suddenly. An interesting hypothesis, which has fairly wide acceptance, is that Cro-Magnon man, with his higher intelligence and superior weapons, displaced Neanderthal man rather quickly in an annihilative sense. To date there is very little evidence to suggest any extensive interbreeding between Neanderthal man and his Cro-Magnon successors, who are representatives of our own species, and thus the widely held present hypothesis is that the story of mankind is woven of two strands—the Neanthropic and the Paleanthropic—the bifurcation from a common ancestral species probably having taken place nearly a million years ago. It may well be, however, that this hypothesis is a little premature, the existing fossil evidence being insufficient to support it. Certainly the Predmost variant of Cro-Magnon man is rather Neanderthalian in several of his anatomical features.

But, generally speaking, we can say that with the advent of Cro-Magnon man we have entered the period of modern man. The era of Cro-Magnon man is thought to have been roughly between 40,000 and 13,000 years B.C. The skeletal differences between Neanderthal man and Cro-Magnon man are striking. In contrast to Neanderthal man, Cro-Magnon man is very tall, many of the male specimens averaging six feet in height. The brain-cases are large, averaging in the male specimens, 1700 and 1800 cc. Gone are the usual paleoanthropic features, the heavy supraorbital ridges, the receding forehead, the low skull-vault, and the protruding occiput. The skulls are modern in every respect, distinguished perhaps only in their greater massiveness.

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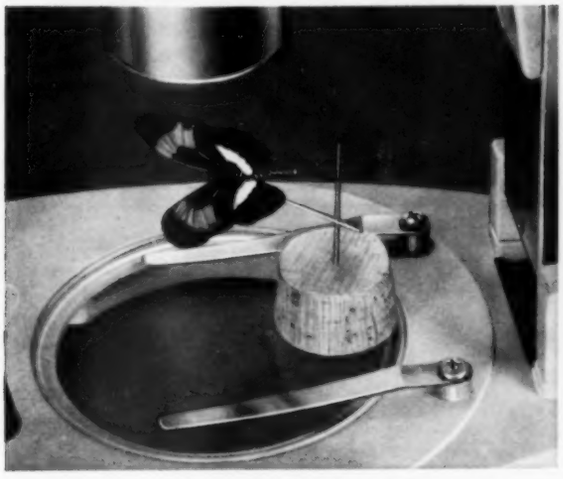

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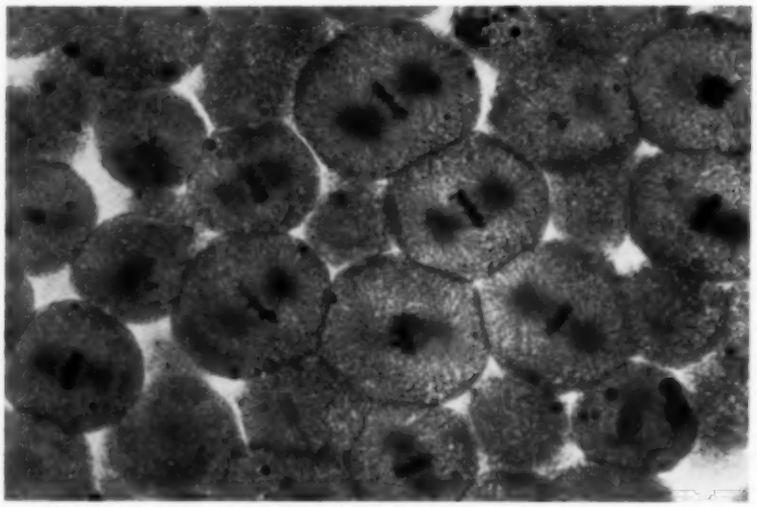
record and pattern of fossil man. And yet there is so much we have been constrained by the limitations of space to omit. There are, for example, the Steinheim and Ehringsdorf skulls. There are also the interesting Neanderthaloid variants including the Rhodesian skull, the Mount Carmel specimens, and very recently discovered Shanidar skeleton[8]. The latter discovery in a cave in Iraq near Shanidar village of a complete Neanderthal skeleton, along with two others in the same cave, now show definitely that Neanderthals were not a homogenous people but a varied racial group consisting of at least three variants. Classic Neanderthal man tends to be a solidly built short little creature with short forearms and calves, a receding forehead and chin, and a solid shelf-like brow ridge; the hybrid type found in Israel is taller (averaging 5 feet 7 inches) and slimmer, has a fuller forehead and chin and a grooved brow ridge. The newly found Shanidar skeleton possesses his classic cousin's stubby body build but his Mount Carmel cousin's grooved brow ridge. Thus year after year does the work of discovering and learning about prehistoric man continue.

If we were to summarize the salient features this paper purports to establish, we might begin by noting that fossil evidence to date suggests that mankind has existed at at least three levels, the Pithecanthropian, the Neanderthaloid, and the Homo sapiential, ranging back in time at least a half or more million years. Definitely known artifacts, attesting to man's existence, go back nearly a million years. Obviously flint artifacts are more durable than human bone. Somewhere between the beginning of the Pleistocene period and its middle—or roughly 750,000 years ago—there existed the strange little group known as the Australopithecinae at once human and simian to a baffling degree in their physical structures, definitely hominid, but on which side of the ledger—human or simian? Can the term "man" or "human" be applied to Australopithecus? Science as yet is not in a position to say. There are the humanlike limbs and teeth together with an ape-sized brain. There is some evidence that Australopithecus was a tool-user but none at this date that he was a systematic tool-maker, which brings us to the leading thread around which the fabric of this paper has been woven, namely, the physical criteria whereby fossil men are distinguished from fossil anthropoid apes.

We have shown that the skeletal features which distinguish ape from man retrogressively fade and tend to blend into one as we move backward in time into the Pleistocene period until that point is reached where it is almost impossible, on an anatomical basis alone, to distinguish fossil ape from fossil man. From this pattern a single factor emerges: when this point is reached where, anatomically speaking, man and ape merge, the limbs, physical posture, and teeth provide no sure criterion for distinguishing one from the other. But the size and contours of the skull are predominantly more apish than human. This fact, coupled with the absence of any undisputed known artifacts, leads scien-



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tists to conclude that Australopithecus was probably a very advanced kind of ape which just missed by a very narrow margin becoming man. As we move forward in time we have the fossil evidence of creatures whose brain-cases are larger than those of any known ape, but yet are smaller than those of modern man. We have also the concomitant evidence of gradually increasing skill in tool-making, from the earliest crude hand-axes and chopping tools to the highly finished blade-work of Cro-Magnon man.

Nevertheless a great gap remains between ape and man, which is inexplicable on purely scientific grounds. While the evolutionary theory respecting the origin of man's body is fairly well established and very strongly compelling, it does not follow that anyone has any scientific basis for concluding that the differences between man and ape are purely quantitative. While apes have been known to manipulate tools and to insert one pole into the end of another bamboo pole for the purpose of reaching a bunch of bananas, no ape has ever been known to conceive the idea of fashioning a stone or stick into a tool for use in an imagined future[10]. It is precisely the power and capacity for abstract thought which separates by an impassable gulf man from the ape. The ape perceives. Man alone conceives. As a consequence, only man speaks; only man makes tools systematically; only man controls and uses fire; only man buries his dead; only man adorns the walls of his dwelling with paintings. Only man wonders. Only man knows that he has probably evolved. ●

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2. The general reader interested in pursuing further the study of fossil man will find an ever-increasing amount of excellent inexpensive paperback literature available. The following are suggested: A. S. Romer's *Man and the Vertebrates* (Pelican Series, published by Penguin Books, Inc.; 2 vols.), J. M. Smith's *The Theory of Evolution* (same series), G. G. Simpson's *The Meaning of Evolution* (Mentor Series, published by the New American Library of World Literature), J. Huxley's *Evolution in Action* (same series), Lecomte Du Nouy's *Human Destiny* (same series). It is well to remind the reader that the latter three write as philosophers as well as scientists, but are predominantly scientists, and therefore speak with weighty authority only on the scientific issues involved. In the Phoenix Book series, published by the University of Chicago Press, there are two excellent fundamentally scientific little works, W. E. Le Gros Clark's *History of the Primates* and K. P. Oakley's *Man the Tool-maker*.
3. *Life* magazine (August 18, 1958), pp. 62-64.
4. W. E. Le Gros Clark, *History of the Primates*, p. 97.
5. K. P. Oakley, *Man the Tool-maker*, p. 3.
6. G. Vandebrock, "The Origin of Man and the Recent Discoveries of the Natural Sciences", in *God, Man and the Universe* (New York: P. J. Kenedy and Sons), p. 110.
7. The bulk of current scientific opinion inclines toward the view that Australopithecus was an ape, but this opinion appears to rest quite heavily on the evidence of brain-size and skull contours; thus, for example, E. A. Hooton, *Up From the Ape* (New York: Macmillan Co., 1946), p. 288. Le Gros Clark, however, expresses a more cautious view, *op. cit.*, p. 118, citing the lack of deliberately manufactured tools and implements as the weightier basis for his opinion. One infers that he would be quite willing to revise his opinion should this additional evidence ever be found. Father Ewing, S. J., *op. cit.*, p. 114, appears to be of this mind also.
8. For the actual history and descriptions of the fossil dicoveries the reader will find E. A. Hooton's work meticulously complete. For the less exacting and more casual reader there are two well-written popular accounts, A. Leroi-Gourhan's *Prehistoric Man*, and C. R. Knight's *Prehistoric Man*, which have recently appeared in the book marts at cut-rate prices.
9. *Life* magazine (November 4, 1957), pp. 115-118.
10. K. P. Oakley, *op. cit.*, p. 4.

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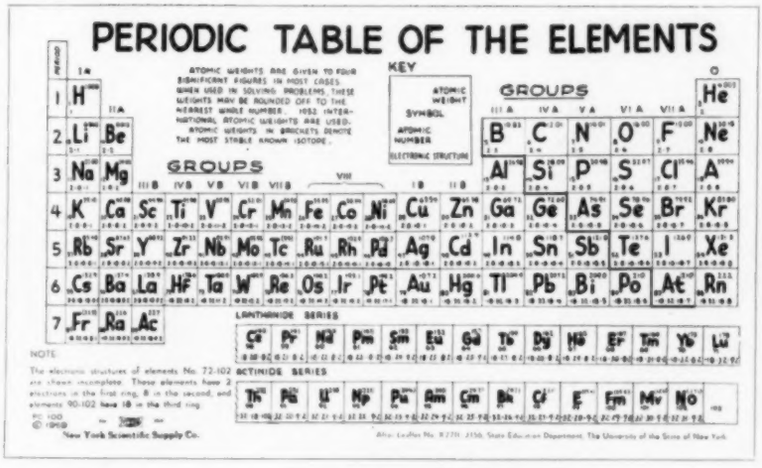

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American Tree Farm System

(Continued from Page 50)

of the forest, resulting in more young trees, shrubs and plants needed by wildlife. They also find food and hiding places in the fallen tree tops and other discarded parts of the tree after logging. All in all, Tree Farmers seem to be demonstrating the thesis of many foresters that when Tree Farming standards for wood production are met, most other forest benefits are provided as by-products. This is called "multiple use" management.

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★ ★ ★ ★ ★

Saliva and Salivary Glands

(Continued from Page 54)

Recently, a test has been devised for the determination of the sex of the unborn child[8] by presumably coupling a sex hormone found in saliva with dinitrophenyl hydrazine. The exact nature of the hormone is not known, however, it is believed to be one of the male sex hormones, since the positive reaction, that is, the coupling of the hydrazide, takes place only when a male fetus is present.

Saliva, then, is not the simple fluid most people assume it to be. Though it contains only approximately 0.5% of solid material, most of the basic biochemical substances have been found to be present. The future may hold a greater role for saliva and the salivary glands in diagnosis and disease control in humans. ●

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AO Reports on Teaching with the Microscope

Tranquilizers for Paramecium . . . or the care, feeding and observation of infusoria.

Generations of microscopists from Leeuwenhoek and Hooke down to present day biologists and medical workers have spent endless hours studying the ameba. You would think it had no further secrets left to fascinate present-day scientists. But not so! The ameba and its companion denizens of the primeval slime have come to us in unbroken genealogy from a period eons before the age of dinosauers . . . from the very beginning of creation itself. As a basic uni-cellular living organism, the ameba is more intensely studied today than ever before by scientists seeking the final elucidation of the life processes. Protozoa remain fascinating subject matter for student microscopists in the Biology classroom. With all this in mind, we offer the following generally well-known tips on the care, feeding and observation of the wee beasties.

MATERIALS:

Glass dish, approximately 8″ in diameter, 4″ deep (ordinary casserole pyrex dish); piece of plate glass; several petri dishes; timothy hay; pondweed; Methylene Blue; carmine or indigo powder; iodine; microscope slides; cover glasses; compound microscope; stereoscopic microscope.

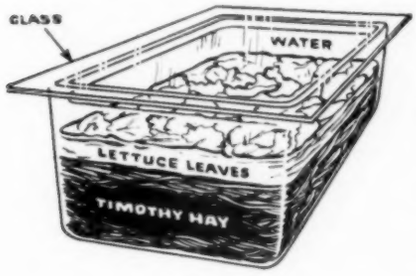

Fig. 1

HAY INFUSION:

Half fill 8″ dish with loosely packed timothy hay. Boil about two quarts of tap water for 5 minutes. Allow to cool and pour enough into dish to just cover hay. Add a 1 inch layer of the pondweed, Ceritophyllum. If out of season, or otherwise unobtainable, use unwashed lettuce leaves. Add more water to bring to within half-inch of top of dish. Cover with plate glass (see fig. 1). Keep in warm (normal room temperature), well lighted room . . . avoid strong, direct sunlight. Prepare several such cultures over a two-week interval. A brown, slightly odoriferous scum should appear. If scum disappears, or if whitish mold appears, discard culture. In a favorable culture, ameba will appear in 6 to 8 weeks. Additional protozoa will also be present, including Paramecium, Stentor, Euglena, and rotifers. Culture should thrive for 6 months or longer. Several such cultures will assure a plentiful supply of protozoa at all times during the school year. Occasionally add a malt tablet or few grains (pulverized) of rice as nutrient.

Fig. 2

OBSERVATION THROUGH STEREOSCOPIC MICROSCOPE:

Use a pipette to transfer some culture to petri dish . . . search the bottom of the culture dish for ameba, look along the sides where light is strongest for Euglena and look beneath decaying vegetable matter for Paramecium. Place petri dish on microscope stage. The stereoscopic microscope provides the unique advantages of three-dimensional magnification, long depth of focus and wide field of view to reveal, *in toto,* a teeming aquatic jungle of ameba, scooting paramecium, turgid rotifers and spinning ciliates (see fig. 2). If your school does not have a stereoscopic microscope, you may want information about the AO Spencer Cycloptic Microscope, Series 56F-1. Write to American Optical Company, Instrument Division, Dept. R237, Buffalo 15, N. Y. We'll be happy to send complete information at no obligation to you.

The stereoscopic microscope can also be used to establish "pedigree stock", or pure cultures. Simply hunt down the desired specimens with a wide mouth medicine dropper and innoculate a favorable culture medium such as Chalkley's fluid. Prepare Chalkley's fluid as follows:

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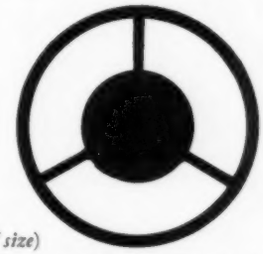
KCl	0.004gm
$CaCl_2$	0.006gm
Water (distilled) . . .	1000cc



(*actual size*)

Fig. 3: Star diaphragm for dark field

OBSERVATIONS WITH THE COMPOUND MICROSCOPE:

DARK FIELD. It is difficult to see detail in live, unstained protozoa. Cutting down light intensity helps. If your microscopes have substage filter holders you can use star diaphragms to achieve dark field effect for better observation of general morphology. Make a star diaphragm out of stiff, black opaque cardboard. Use illustration (actual size) as pattern (fig. 3). Star diaphragm is slipped into filter holder and adjusted until best dark field effect is obtained.

STAINING. To see cilia, flagella and trichocysts, irrigate slide with very dilute iodine solution as follows: place drop of iodine at edge of cover glass on one side and place filter paper at edge of cover glass on opposite side. This will pull iodine under cover glass. To stain entire organism, proceed as follows: pipette some culture into Petri dish. Add Methylene Blue (not to be confused with Methyl Blue) until culture takes on definite blue tint. Observe drop of tinted culture under 10X and then 43X. Organisms will be stained blue for a short while and then gradually will return to normal.

FEEDING. To distinguish between food vacuole and macronucleus of ameba, add a pinch of finely pulverized Carmine or indigo powder to culture specimen on slide. Use cover glass and observe under 10X and 43X. Colored powder is rapidly ingested by ameba and accumulates in food vacuole. Powder grains can also be seen swirling into gullet of paramecium as they get caught in current set up by cilia.

Fig. 4: Photomicrograph of an ameba

SLOWING DOWN PROTOZOA. If the ameba is the tortoise of their aquatic jungle, the paramecium is the hare . . . they literally flash in and out of field of view. Adding a drop of water soluble methyl cellulose (or egg albumen) will slow paramecium and other ciliates and flagellates considerably. You can narcotize them motionless with a small drop of very dilute methyl alcohol. Once anesthetized, your students can attempt photomicrography with their do-it-yourself photomicrographic camera set-up described in an earlier AO Report on teaching with the microscope. If you are using stains, you might want them to experiment with color film.

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The Conservation Concept

(Continued from Page 51)

means form edible material with an efficiency not yet fully understood by man. When this mechanism is completely known and applied, science may be able to produce food and fuel in unlimited quantities.

We shall also have to find substitutes for the non-renewable minerals such as iron, copper, and other metals. Someday, perhaps, the economic reduction of clay, of which there is an inexhaustable supply, to some such element as aluminum may be discovered. Maybe, as scientists perfect new ways of cloud seeding or rain-making, we will someday witness the deserts of the West bloom into a garden spot of America. These and many other benefits will be conferred on man through the superior techniques of science applied to conservation.

Conservation Education

Teaching the need for the conservation of natural resources is clearly a subject of vital importance. Our rising generation of school pupils must have the knowledge that will generate the scientific ideas, skills, and attitudes that will insure the perpetuation of our country's and the world's resources through good maintenance and management. This education offers the soundest investment in the future. It changes the ignorant and thoughtless person into a creative, responsible individual capable of specialized effort for future generations.

However, the place of the conservation concept in the elementary school curriculum is still a controversial matter in many educational circles. Most educators, who have expressed an opinion, agree that some conservation information should be introduced either in a nature study or elementary science program or by integration into the social studies or reading program. There is also wide-spread agreement that conservation should not be taught as a separate area or unit in the primary grades. Above the fourth grade, however, those interested in the improvement of conservation education assert that it should be taught, but no general agreement as to which phases should be emphasized.

There is further agreement that rural children need instruction in the conservation of natural wealth as well as urban children. It may seem reasonable to argue the greater importance for city children, but rural children, however close they live to nature, need the social and economic significance of conservation clearly pointed out.

Moral and Spiritual Values

No consideration of the problems of conservation can serve us completely in a democratic program of education unless such education gives a central place to the moral and spiritual values basic to our conception of life. Albert Schweitzer observes that thinking

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about life and the world leads a man directly and almost irresistibly to reverence for life, and that the principle of reverence for life is the ethic of love made universal. St. Francis of Assisi was such a lover of all life. To such a soul in touch with God, all the world is kindred. So Saint Francis sang canticles of praise to the sun and the moon and the stars; he walked gently among the flowers of the woods, and animals and birds came to him for shelter and protection.

In our criticism of communism we frequently point to its disregard for religion and for the dignity and rights of the individual. Without doubt this accusation is justified, but we cannot continue to make it unless we can demonstrate by our own life and action that we, in a free society, have a real concern for natural and human resources, and the latter regardless of color, creed, or nationality. In other words, conservation education should be soundly based in a living Christian democracy as the true source of our strength.

One way we can convince the world that human freedom is a wise reality is to teach our young people that collective security lies in the development of a sound economy based on a forward-looking conservation policy, not just for the United States and the great nations but for all people. By realizing more fully the implications of the conservation concept in the technical assistance program, we will contribute to the spread of the gospel of a free society by applying the good neighbor policy to the economically less favored people of the East and elsewhere.

For the world at large, the dissemination of the conservation concept is a pressing matter of fundamental education, necessary for the improvement of life in general and the elevation of standards of living. Such scientific aspects of the concept as they affect health, hygiene, diet, agriculture, and the rational use of natural resources may, in the long run, prove to be the most important contribution to the effective implementation of the Point Four Program. This may well be the source of our greatest moral force and our best leadership for peace and stability. For only in a world in which peace and stability is achieved can the inexhaustable resources of the human spirit for progress toward the ideals for which democracy stands be conserved and realized.

This conservation concept fully realized will supply the energy required to solve two of the basic problems on which hang the fate of our nation and our civilization: first, man's struggle to control and conserve the powers and resources of nature; and second, his struggle for that affirmative spirit in himself which wills freedom for all men as the greatest achievement in the conservation of human resources. ●

THE SKY IS THE LIMIT

The fiction of Jules Verne is rapidly becoming fact as the world begins to adapt to a new "space age." Satellites are now in orbit. Sending a rocket to the moon is under active discussion. Outer space travel is sufficiently close for the conducting of military experiments to simulate its conditions.
In teaching, there is a compelling need to give students an opportunity to do more than just read about the universe. Apply visual education, let them see for themselves our neighbors in the solar system and outer space.
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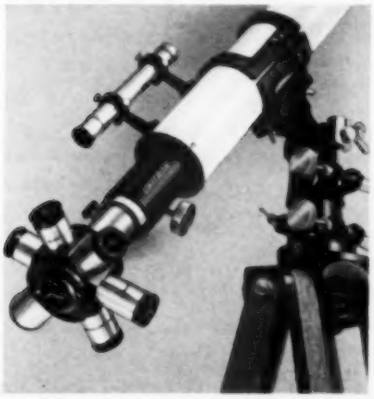

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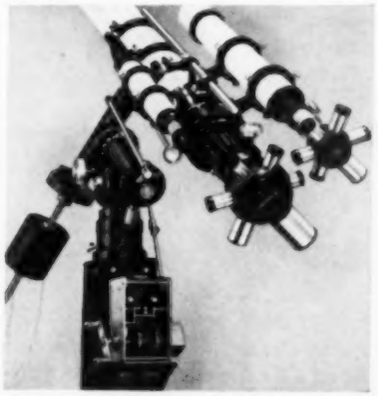

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The Apothecary Jar

(Continued from Page 44)

French porcelain jars date from no earlier than the mid-nineteenth century, and many have been produced during the 20th century in France, Spain and in some Latin American countries. Figure 15 depicts a typical porcelain drug jar of the late 19th century. This jar was manufactured at Limoges, France, after 1891 for direct export to a Spanish speaking country, probably in Latin America.

Another important step in the development of the apothecary jar was introduced by English potter Josiah Wedgwood putting an end to the manufacture of English delftware. One of Wedgwood's many perfections was that of "creamware," which was later christened by Queen Charlotte as "Queen's ware." Wedgwood's "creamware" or "queensware" was a lead-glazed earthenware which was both light in weight and creamy in color and texture. Queensware found a widespread use in ointment and extract jars both in the U. S. as well as in England during the 19th century. Philadelphia pharmacist Edward Parrish described the queensware ointment jars in 1856 as follows: "These vary in quality, in color, and in shape. They . . . should be well glazed, both on the inside and outside surfaces. The best are imported from England. In regard to the shape of jars; the variety called canopy-top is generally preferred, as having a more finished appearance than the flat-top."

In America, the use of glass drug containers predominated over all types of ceramic containers. It is not known definitely when the first medicine bottles were made in America, but it is possible that some were blown at the first glasshouse reportedly built in the woods about a mile from Jamestown in 1608. Many glasshouses arose in the colonies, flourished and declined; most of those begun in the late 17th and early 18th centuries, however, turned out to be short-lived ventures. Probably medicine containers were produced in greater or lesser quantities by all glasshouses. It is known for example that Richard Wistar advertised in 1769 that he made "medicine phials, tubes, globes, laboratory equipment and apothecaries supplies," and in 1771 Henry Stiegel advertised "phials, and other bottles for chemists and apothecaries."

Large quantities of glass apothecary jars called "shop furniture" were produced in the U. S. during the 19th century. Leading producers included the Kensington Glass Works operated for a time by Thomas W. Dyott; the New England Glass Company, later to become The Libbey Glass Works; and Whitall, Tatum & Company. In 1856, Parrish's *Introduction to Practical Pharmacy* made the following comments on glassware of the period: "The American made bottles are of two kinds, those blown and finished without a mould, which are the most transparent and smoothest kind, and those blown in a mould to which I [Parrish] usually give preference from their greater uniformity of size and shape . . . Bottles with wide mouths and ground stoppers, used for solids are called salt-mouths; those with narrow mouths and ground glass stoppers used for liquids are called tinctures . . . The specia jar, consists of a wide-mouth bottle with a lip the mouth of which is covered by a tin top . . ."

As the druggists' "shop furniture" became more elaborate, the pharmacists devoted more attention to attractively labeling his shelfware. Up to the middle of the 19th century, the only satisfactory method of labeling shop furniture was by painting directly upon the glass. This was a costly process if it were handled by an expert "labeller" as they were called, and it was an unattractive method if it were left in the hands of the unskilled. Therefore as the process of color lithography improved, paper labels were substituted for the hand painted labels. To avoid discolorations, a thin coat of clear mucilage and varnish was painted over the label.

Just prior to 1860, another method of applying labels to glassware was introduced. It was called the glass label and consisted of a curved piece of glass which was cemented over the paper label. Then on September 23, 1862, William N. Walton of New York received a U. S. patent for the recessed glass label, which largely eliminated the danger of chipping the edge of the exposed glass label. Figure 16 shows the glass label on a blown salt-mouth bottle on the left, and a Walton recessed glass label on a tincture bottle on the right. Both have glass ground mushroom stoppers.

Today, progress has banished the artistic apothecary jar from the pharmacy, except as a collector's item. But these apothecary jars reflect in a sense the historical evolution of medicine and pharmacy. They are not merely antiques or art museum pieces, but they are truly symbols of a profession. Each jar with its peculiar shapes and decorations, and unique Latin labels has its own significance and each makes its own appeal. The history of the apothecary jar tells both the history of medical sciences and the development of the art of ceramics and glass. This is such a story. ●

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★ ★ ★ ★ ★

Molecular Models

(Continued from Page 47)

c) the carbon atoms in the longest chain have to be numbered to identify the location of attached groups (in this case the two "methyl" groups). The numbering has to be started from that end of the longest chain so that the sum of the actually used locants is smallest ("2,3" in this case).

While the application of these rules is so familiar—not only to the teacher, but also to the second semester student—as to be automatic, it is obvious that the finding of the name is an undertaking to the beginner. We felt for a number of years that an undue amount of time has to be expended on the teaching of this detail and we looked for a low-cost specialized tool.

Since the problem consists in "seeing" the longest chain, we provided rubber balls with copper wire hooks so that strings or chains can be formed as shown in the illustration. Thus, two-dimensional molecular models are formed, to be picked up by hand at its "ends" until the longest chain is found.

It seems that balls of 1½ inch diameter are clearly visible within twenty-five foot distance, while large lecture halls require balls of 6 inch diameter.

The construction of this device is simple. The balls are pierced with an ice-pick first in one direction, then again at a 90° angle. Copper wires (12 or 16 gauge) of a length about double the diameter are inserted and curled into hooks as illustrated.

We can highly recommend the use of these two-dimensional models as tools for the teaching of organic nomenclature. ●

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New Books

A Guide To Nuclear Energy

• *By* R. F. K. BELCHEM. The Philosophical Library, Inc. New York. 1958. Pp. 77. $3.75.

This book is an excellent introduction into the intricacies of nuclear energy, particularly the theory and design of nuclear power reactors.

Following, a short but very lucid chapter on the basic principles of nuclear fission, are chapters on the constituents of a nuclear reactor, types of reactors, reactor fuels, materials used in reactor design and useful applications of radiation.

Even though the author is British and most of the examples are taken from British nuclear industry, the book fulfills the purpose stated in the preface, namely, "to explain to persons without specialized knowledge the theory of nuclear reaction and the manner in which nuclear power reactors function."

We recommend this book to all who desire to get acquainted with this field.

Kurt C. Schreiber
Chairman, Dept. of Chemistry
Duquesne University

Teaching A Unit In Astronomy

• *By* J. RUSSELL SMITH, Vantage Press, New York. 1958. Pp. 149. $2.75.

There is general agreement that the major aim of elementary science teaching is the presentation of the child's total environment in meaningful terms. Not just the ordinary and immediate environment, but the broad patterns of the earth, the universe, and the vastness of space.

This little manual is a convenient resource unit that helps the teacher and pupils to view the earth as a platform from which to project the many elements of the universe in space. Many elementary teachers have hesitated to take this view because of the feeling that they were not sufficiently informed to handle this more specialized area of astronomical science.

—*Photo by* V. DEER, C.S.Sp.

Here is an excellent unit to assist the harried teacher who must cover the field of elementary science from grades 1-9. It is timely, coming as it does, at a period in our culture when we are about to penetrate the universe far beyond the curtain of the earth's atmosphere. It reviews the basic themes and meanings of the subject at the various grade levels, then follows with suggested activities that are well explained and illustrated. The last two chapters contain such convenient teaching aids as source lists of books, films, reference works, as well as an astronomical glossary, many charts and star maps.

F. Kleyle

Exploring Physics

• *By* RICHARD F. BRINCKERHOFF, JUDSON B. CROSS AND ARTHUR LAZARUS. Harcourt, Brace and Company. New York. New Edition 1959. Pp. XII + 724. $3.96.

EXPLORING PHYSICS is designed, according to the authors, for teaching academic physics at the high school level. Its aims are to encourage student interest in the world in which he lives by clearly explaining physical phenomena heretofore merely assumed by the student, to arouse his curiosity enough for further inquisition into the physical universe, and to develop scientific attitudes and habits by utilizing the scientific method in the text.

The material covered by the authors is adequate, functional, and current. Scientific data presented to the student are expressed in simple terms. Technical terms are clearly defined, and examples are given as to their relationship with things the student may encounter every day. The style used by the authors is informative, interesting, and stimulating.

The illustrations are of exceptional value. Numerous colored plates, along with illustrations on almost every page, emphasize the topic under consideration.

Broad black lettering is utilized effectively in designating paragraph content. Red lettering is used for important formulas. The structure given to the paragraphs; namely, placed in columns, makes it easier to read the material with greater comprehension.

The book is organized into seven comprehensive units which are then divided into chapters. The chapters are broken down into sections. Following the sections dealing with physical laws, a sample problem is given; after which, problems of increasing difficulty are presented to the student for solution. Helpful hints as to the proper procedure in problem solving are sometimes prepared for student enlightenment.

The book is modern day in its approach to physics. It treats important advances in physics, such as satellites, jet propulsion, and rockets. EXPLORING PHYSICS also encourages students to plan careers in physics with three special interchapters under the title "Extending Your Studies." I feel this cannot be stressed enough with America's need for physicists ever on an increasing demand.

The appendix under the title "For Reference And Further Study" is extremely beneficial for both the student and teacher. It presents a review in mathematics which the student might need in order that he can master any physics problem. Also given is an example for an advanced placement examination for possible college credit.

In addition to these aforementioned aids, a table of contents, technical vocabulary, and various mathematical tables facilitate the use of the textbook.

It is my opinion that EXPLORING PHYSICS represents a valuable instructional aid in content, illustrations,

exercises, and organization. The book presents material related to pupil needs in terms of maturity interests, assists the student in formulating basic scientific concepts, and develops a background and understanding of scientific data through utilization of the scientific method in learning and problem solving. The authors have succeeded in presenting their material by fulfilling their aims and objectives through clarity, exemplification, and illustration.

Paul E. Blake
Student: School of Education
Duquesne University

★ ★ ★ ★ ★

New Kind of Freshman

(Continued from Page 40)

nometry, instead of that deadening drudgery of solutions of triangles by all means and methods, ad infinitum and ad nauseum.

I propose and urge you of the secondary schools to take this advice and come up with a better prepared group than you have been able to do up to now. Perhaps you do not know that many colleges and universities must give pre-freshman courses in mathematics to many entering students. Some even give pre-pre-freshman courses.

Finally, I quote some figures given out recently by one of our state universities. Only one third of the applicants were able to pass tests given at the university to decide whether to place them in college mathematics or not. *One fifth* had to take pre-college courses. *One fourth* had to take pre-pre-college courses. This is appalling, and here is what a paper put out by the university has to say about it, "Without affixing blame anywhere, let's regard some of today's children as non-educable on the college level and create junior colleges or institutions where they can either learn less expensive and lower grade skills and cultures, or work their way up to the universities . . . With a doubling of the university's enrollment by 1970, the 'spoon feeding of illiterates' will be a luxury we can no longer afford."

I sincerely hope that all levels of education can come to agree with me on this situation and bring about a more happy situation in the near future. ●

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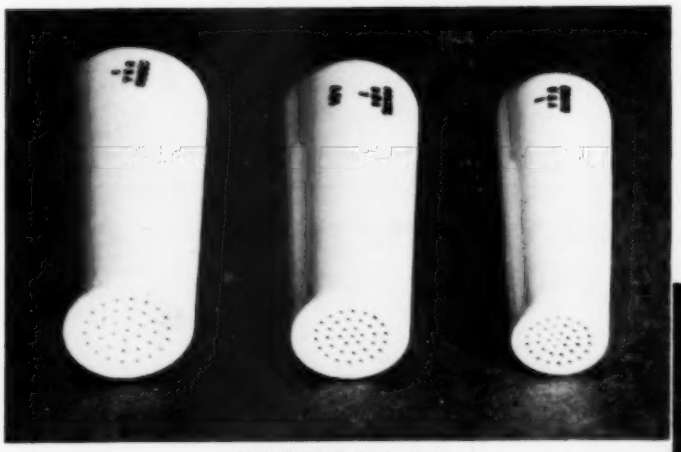

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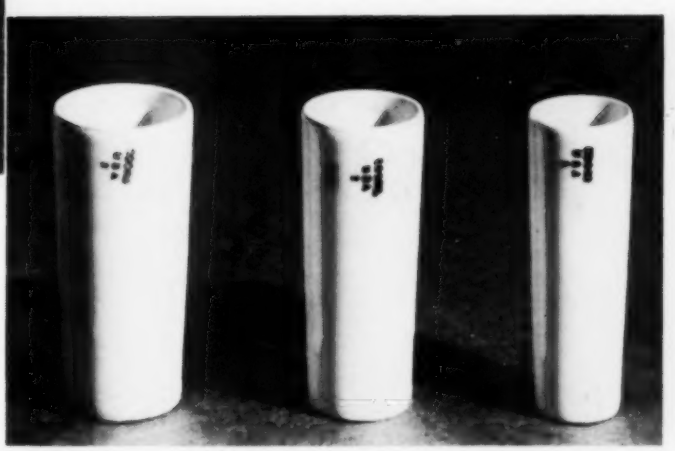

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(The moon requires exactly the same time to circle the earth as it does to make one full turn on its axis; thus, it always turns the same face toward the earth and the reverse side is not visible. Slight wobbles in the moon's motion account for the visibility of 59 per cent of the surface from the earth.)

In addition, side panels on the map provide detailed, blown-up photographs of some of the major features of the moon. The new map also contains full-color drawings of the Jupiter and Vanguard rockets and the first American satellites.

On the reverse side is a map of the planets, showing their size and distance relationships, as well as information and diagrams illustrating the diameters of the planets and the sun, eclipses, tides, and seasons, the earth and its atmosphere, and Halley's Comet.

The legend on the map has the following to say about the moon:

"The moon has always fascinated man. Revolving around the Earth every 29½ days, the Moon shows only one face to us as it rotates once on its axis in every revolution. About 41 per cent of the Moon can be seen all the time and another 18 per cent some of the time.

"Seen through a telescope, this satellite presents a weird and startling landscape. Vast plains—named oceans and seas by the ancient astronomers who believed that these areas had been covered by water ages ago—extend over much of the surface. The largest is Oceanus Procellarum (Ocean of the Storms).

"Thousands of craters pock-mark the face of the Moon. Clavius, one of the largest, is about 146 miles wide and 20,000 feet deep. Mountain ranges are 5,000 to 20,000 feet in height, and some peaks tower over 30,000 feet. These are rugged features considering that the diameter of the Moon is only 2,160 miles, compared with the diameter of the Earth, which is 7,918 miles.

"The pull of gravity of the Moon is only one-sixth that of the Earth. Dependent on the Sun for its light and heat, temperatures on the Moon range from 215 degrees F. above zero in the day to 240 degrees F. below zero in the night. As far as is known, there is hardly any atmosphere on the Moon and it is believed to lack water; also, it is conjectured that life is nonexistent there."

The moon has been carefully studied since the time of Galileo and the invention of the telescope. Giovanni Riccioli, an Italian astronomer, named the craters and mountains after philosophers and other astronomers in 1651. First photographs of the moon were taken by 1850.

Rand McNally's map of the moon is based on photographs taken by the Lick Observatory, at the University of California, Berkeley. Enlargements of physical features are from photographs taken by the Mount Wilson and Palomar observatories.

The new map is 46½ by 26 inches in size, and folds to 6½ by 10½ inches. It is available in book, stationery and department stores, and sells for $1. ●

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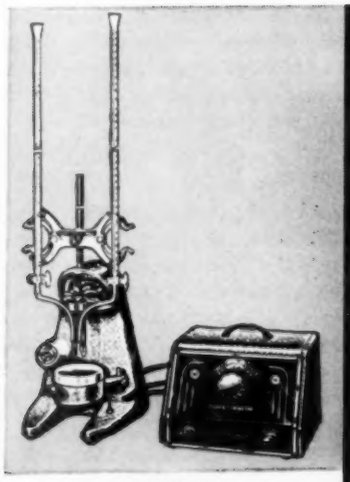

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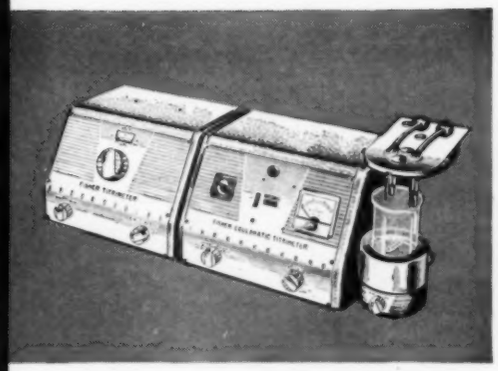

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Atomic Science

(Continued from Page 52)

of the heart, so that heart disease and heart attacks may be controlled. All of these form the frontiers of the future, for the youth of today . . . here are old worlds which must be conquered by new ideas, namely, to remedy illness and restore health to the sick.

Other fields lie ahead too. Everyone knows of the H-bomb, an instrument of destruction unequalled in the whole history of the human race. But how many know that right now, today, there are as many scientists working on the problem of making peaceful uses of the H-bomb reaction available to the human race? Since the H-bomb is made of hydrogen, a gas readily available, even from the air itself, the question of making an atomic power plant from such a substance would be much cheaper and less dangerous in some health respects than a power plant using Uranium. Moreover, by use of radiation from certain minerals, it is possible to process food so that it can be kept flavorsome over long periods of time without spoiling.

But what of the mysterious but mighty forces which hold the atom together? Have they ever been studied? Yes, but no one has ever reached a satisfactory answer. We are still waiting for some young man or woman to give it. For the whole field of atomic energy belongs to the young: it is a game much like baseball, by the time a scientist reaches 30, he has made his brilliant discoveries. He can continue to do much good work, but the outstanding discoveries are made by men who are well under 30.

What does this accent on youth mean? Simply this: if your students are interested in Science and in learning more about it, then begin them as young as you will. Encourage your pupils to study every moment they can during their high school days so that they will be able to go to college and finally to continue work as a scientist. Many lads think that scientific success can come in one swoop after they have wasted four years in high school . . . but it is not so: a well grounded high school course is demanded before getting to college.

Many other fields of atomic energy and its neighbors lie ahead. Some may want to be engineers who build the machinery which harnesses the atom. A few may want to be mathematicians who perform the necessary calculations which the engineer and scientist use. Still others may prefer to be the doctors, physicians, who apply to their own medical problem the results of the new discoveries in atomic research. Another group may wish to be electronics experts who build the new instruments which are used to measure these atomic radiations.

So to Catholic high school students, I address these words: remember whatever you choose, or whatever vocation in life God gives you, remember one thing: *you are Catholics*, and as such you are expected to be different, because your life is guided by your faith. It is to you that others will look for direction in doing things the right way according to God's law, providing that you have proved your worth to them in your own field. It is a challenge, much bigger than the winning of a new frontier, or the taming of a new continent . . . a challenge which rests on your shoulders, you who are the hope of the future; the fathers and mothers of the new generation, the sons of the present and the Catholic youth of today.

Sometimes you as teachers feel that the job is hopeless; actually it is not. So keep up your good work and make it a bit better. And just as St. Francis of Assisi wrote in his "Canticle of Creatures," in the 13th century praising fire, sun, moon, earth and even death . . . I feel sure that today he would add another verse to praise this newest evidence of God's love for man: "Blessed be Thou, O Lord God, for thy creature, Brother Atom. For in him Thou has given some of Thine own almighty power in such a tiny space." ●

★ ★ ★ ★ ★

Mathematics Curriculum

(Continued from Page 46)

a fraction may be multiplied by the same number without changing the value of the fraction." Yes, $2/3 \times 3/3 = 6/9$, $2/3 \times a/a = 2a/3a$, but $2/3 \times 0/0 = 0/0$, which is indeterminate. This shows the necessity for placing limitations on certain things. Division by zero is not defined, and therefore that concept which has found its way into words should say "the numerator, etc. . . . by the same number except zero with . . ."

One of the unique features of the UICSM first course is the absence of verbalization of generalizations for "short cuts." Through exploratory exercises the pupil is led to make his own generalizations. For example, the so-called "rules" for operations with real numbers are not stated until the student has grasped the concepts.

After this summation of the program outlined for us by educators in the field of mathematics, we are liable to think it can't be done by us. Our teachers are not trained in these lines. In fact, the inadequacy of teacher preparedness and the lack of adequate textbooks are the two chief deterrents to any unusual departure from the conventional order. The National Science Foundation, the Carnegie Foundation, and industrial leaders, who realize these handicaps to immediate change, have allocated large sums of money to preparing better qualified teachers of mathematics. Any who possibly can, should take advantage of the splendid opportunities being presented. While we cannot all rush off and take courses in new theory, we can direct our professional reading matter into these new channels, so that we will broaden and deepen our knowledge of the mathematics we teach.

Another very effective way for keeping in touch with modern advancements in the teaching of mathematics is joining professional organizations. We in

Pittsburgh are especially fortunate in having a diocesan organization of science and mathematics teachers. Many of the teaching-sisters and brothers hold membership in the Western Pennsylvania, Pennsylvania, and the National Councils of Mathematics Teachers. During the past year we had opportunities for hearing Dr. Max Beberman of the University of Illinois Mathematics Project, Dr. N. Levine of the University of Pittsburgh, and Dr. Stanley Dice of Bucknell University. All of them have given us insights into modern mathematics.

In the introduction of this program the only problem children will be the teachers, especially those who insist on teaching the way they were taught and who cannot re-orient their way of thinking. Our students will be no problem at all. They will learn whatever we teach them and not realize we are imparting new theory.

While there is no Catholic science in mathematics as such, our civilization is impregnated with mathematics and we as Catholic teachers must see that our students are sufficiently prepared for today's challenge. We have an obligation to see to it that our schools are as Pius XI said in his encyclical on the Christian Education of Youth "perfect schools not so much as the result of good methods as of good teachers, thoroughly prepared and well-grounded in the matter they have to teach." ●

★ ★ ★ ★ ★

National Foundation Expands Objectives

NEW YORK — A program that will permit a scientific assault on major health problems of the nation, with arthritis and birth defects as initial new targets, was announced recently by the National Foundation for Infantile Paralysis.

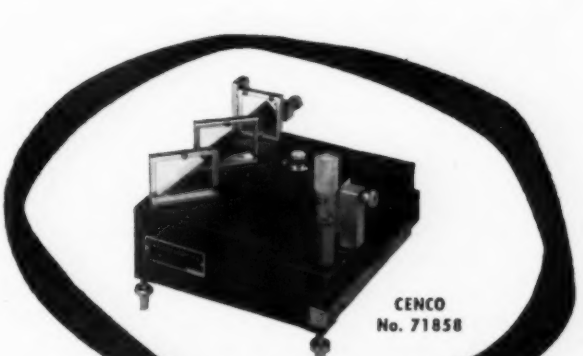
Basil O'Connor, president of the organization that made possible the Salk polio vaccine, outlined its broad new program of future attack on disease and disability.

While carrying on the winning fight against polio, the National Foundation, as it now will be known, will continue its history-making virus research program and investigations of disorders of the central nervous system, and will add research and patient aid in arthritis and birth defects (congenital malformations), Mr. O'Connor said.

The expanded program will be financed through the traditional March of Dimes conducted each January by volunteers in 3,100 county chapters across the country.

Mr. O'Connor said:

"This is our concept for the future: The development of an organized voluntary force in the fields of medical research, patient care and professional education, flexible enough to meet new health problems as they arise, with specific goals initially.



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"The heart of the new program is research. Research will be expanded from where it is now, without the restriction of being confined in the future to a single disease. Professional education also will be expanded to cover training of personnel both for research and patient care in all areas of activity."

Freedom to follow research clues wherever they lead will be combined with necessary limitations on patient aid in the beginning, Mr. O'Connor explained.

The limitations result from the enormity of the patient care problem: At least 11,000,000 persons have arthritis and rheumatism; 250,000 children are born with significant birth defects each year (excluding birth injuries); an estimated 150,000 persons who have had paralytic polio still will require some assistance in the years ahead.

It is planned to offer patient aid at first only to arthritis patients through 18 years of age and to children suffering from malformations of the central nervous system also through age 18, he said. Some 16,000 childhood arthritis sufferers can be expected to seek treatment each year and about 8,000 patients annually have birth defects of the central nervous system that are treatable. Among these conditions are: spina bifida (open spine), encephalocele (open skull) and hydrocephalus (water on the brain).

To shape a broad program in patient aid in arthritis and birth defects, much must be learned about precise numbers of patients, the number and quality of existing facilities and the availability of qualified personnel, the National Foundation president said.

"Our objective in patient care is to continue the polio job until it is finished," he explained. "We have a moral obligation to do this and the American people expect us to recognize this responsibility. We shall begin patient care in arthritis and birth defects, first, where it will do the most good and, second, on a scale commensurate with the public's willingness to finance it."

While it is not planned initially to provide patient aid for children born each year with congenitally caused mental retardation, Mr. O'Connor said, the research program of the National Foundation may offer new hope in prevention and treatment of this problem.

The new program was adopted after five years of unprecedented investigation of areas of need in the health field and careful assessment of the strengths of the National Foundation that could be applied to other problems. Conferences were held with medical, civic and governmental leaders, as well as representatives of National Foundation chapters from all regions of the country.

"As an organized force for medical research, patient care and professional education, we have chosen the broadest program of all," Mr. O'Connor concluded. "Through it, we hope that infantile paralysis one day may be considered only a fortunate beginning." •

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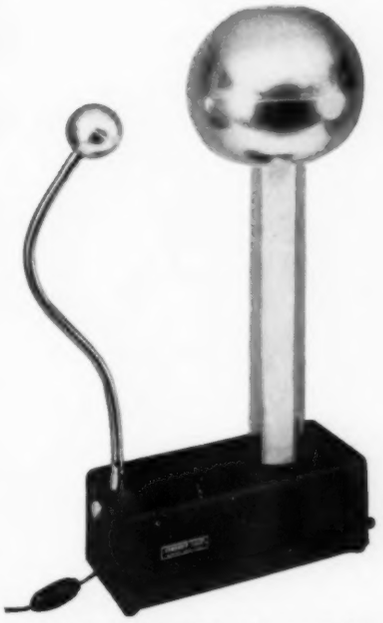

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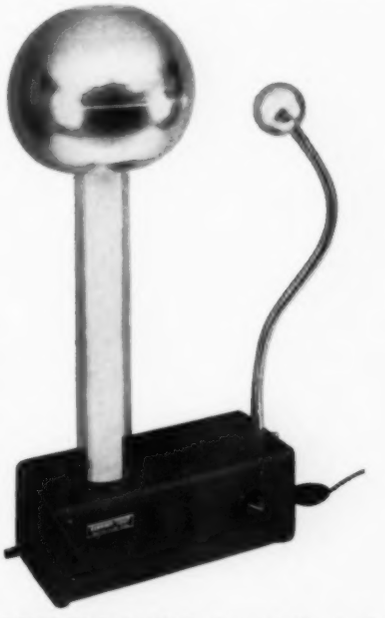

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